Abandoned road, creek, erosion, woodland and farmstead on the upper Ganaraska

Canada Advisory Committee on Reconstruction
estudies and
report
No.

THE GANARASKA WATERSHED

A STUDY IN LAND USE WITH RECOMMENDATIONS FOR THE REHABILITATION OF THE AREA IN THE POST-WAR PERIOD

"How can people do such things to their own country—weaken its base, befoul its beauty, darken its future—How can they do such things and seem never to realize what they are doing? How can they countenance and join in a continual defacement and destruction of the body of their land?"

—*RUSSELL LORD.*

(Over the page)—*Throughout the history of the watershed the forest has formed a "back-drop" for the whole area in all its commercial and community life—White Pine on the 7th Concession of Hope Township.*

A REPORT ON

THE GANARASKA WATERSHED

A study in land use with plans for the rehabilitation of the area in the post-war period

BY

A. H. RICHARDSON

Forest Engineer, Department of Lands and Forests, Ontario

Chairman, Interdepartmental Committee on Conservation and Post-war Rehabilitation.

With an introduction by

DR. R. C. WALLACE

Chairman of the Sub-Committee on Conservation and Development of Natural Resources, of the Dominion Advisory Committee on Reconstruction.

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INTRODUCTION

DETERIORATION of soil, due in large measure to the removal of forest cover, has given rise to serious problems in many parts of Canada. The soundest and most economical methods must be found by which such land may be brought back into productive use. It is now well recognized that conservation projects should be included among the major enterprises, both for providing employment in the immediate post-war period and over the longer term, to help to stabilize the economy as a whole. They should also be a source of sound public investment at times when private investment declines. The organization of this work on a nation-wide basis will not be realized unless the techniques are fully understood. This is the special post-war application of the present study.

On any basis, conservation is a pressing need. It is far from sufficiently realized how urgent the task of soil conservation is. If southern Ontario, in which the Ganaraska region lies, be taken as one of the older areas of Canadian settlement, it was estimated twenty years ago that 8,500 square miles of land was marginal or submarginal for agriculture. Recent observations show that in spite of the expanded conservation programmes of the government in recent years, the submarginal areas are growing larger, the water in streams and wells is becoming less, and erosion of different types, including topsoil washing on agricultural land, is increasing. At the present rate at which remedial measures are being applied, it is estimated that it would take several hundred years to deal with the problem.

Conservation work, in Ontario as elsewhere, needs to be greatly accelerated. The post-war period should be regarded not merely as an emergency, but as a time of great opportunity for programmes designed to re-establish the value and use of basic resources. If these programmes are planned systematically, and from the broad viewpoint which is desirable, they can provide a variety of employment. Much of the work will be temporary or seasonal; but a proper policy of conservation, and the undertaking of a series of projects all across the country, should also provide a number of long-term or permanent jobs. "Conservation" is apt to be interpreted as either soil restoration or reforestation; but what is really involved is the survey of all resources, leading to multiple-purpose rehabilitation. As this report indicates, a considerable variety of remedial projects is called for, involving opportunities for training and education. They are opportunities that ought to appeal, not only to men demobilized from the services, but to others who will be looking for new occupations, temporary or permanent, after the war.

It is now recognized that conservation and rehabilitation programmes should extend to a whole region. In particular, a watershed area sets the natural limits to such regions so far as water, soil, vegetation and forest resources are concerned. The Prairie Farm Rehabilitation (P.F.R.A.) programmes are the most important example in Canada, but the Tennessee Valley (T.V.A.) is probably the most outstanding example of positive regional development. Compared to these, the Ganaraska Watershed area is small; but its importance is greater than its size. The area was deliberately chosen from the older settlement areas of Eastern Canada to demonstrate what intensive surveys and plans for future work should aim at. It was undertaken not as a routine or maintenance survey, but as a much needed piece of research in Canadian conservational procedure. Its purpose is to give more exactness to (1) the specific procedures and techniques involved in the conservation and rehabilitation of a given area, (2) the cost of the necessary remedial projects, (3) the amount and type of employment that will be provided. The techniques include the preliminary surveys, as well as projects and services to be undertaken, both immediate and long-term. It thus provides an opportunity to review and improve the technique of conservation surveys, such as are still necessary in other parts of southern Ontario as well as elsewhere in Canada. And in particular it has been developed as far as possible as a gauge or yardstick by which the cost and employment possibilities of larger projects can be computed.

The area through which the Ganaraska River runs is approximately one hundred square miles in extent. Around the Port Hope area, where the river empties into Lake Ontario, there are still flourishing farms. But a great part of the headwaters is today a barren waste. Its prosperous days of lumbering, settlement and substantial contribution to Canadian wealth are merely history, although history that is all too recent in terms of the exploitation and exhaustion of resources. While the major purposes of the survey were to determine how a balanced redevelopment of the resources of the watershed area could be carried through, it has seemed valuable, in order to point the lesson of the lack of conservation, to recapitulate some of this history.

The principal work of analysing the resources has been undertaken as comprehensively as possible. Thanks to the contributions of the various specialists, the surveys extend to climate, soils, vegetation, forestry, physical and economic aspects of agriculture, plant diseases, entomology, wildlife, waterflow and utilization. The field work for the basic land use survey was done under the general direction of Mr. A. H. Richardson, chairman of the Interdepartmental Committee appointed by the Government of Ontario; and, as indicated in the report, many specific surveys have been added. The result is that the report includes scientific data of types not usually included in routine survey

reports. From the experience of such techniques, it is hoped that future standard surveys can be improved and expedited.

The initiation of the survey goes back to the Guelph Conference. In the spring of 1941, several groups interested in the conservation of natural resources sent delegates to a meeting at the Agricultural College at Guelph, for the purpose of formulating a programme, and of urging government participation in such projects for the post-war period. The Guelph Conference included in its personnel municipal officers, naturalists, hunters and fishermen, war veterans, foresters, agriculturists, biologists, and teachers, and was a representative cross-section of the citizens of the province. Subsequent to this meeting, representation was made to the Dominion Advisory Committee on Reconstruction and to the Prime Minister of the Province of Ontario, with the result that the Dominion and Ontario Governments agreed to collaborate in a sample or "type" survey. Later a similar agreement to share the costs of publication of the report was reached.

The practical conclusions of the report are that in the Ganaraska area a rehabilitation programme can be carried out which will provide work for 600 men for a period of approximately two years. The projects would include woodlot improvement, tree planting, erosion control, dam construction, the organization of recreational centres, and farm improvement. What applies to this area applies in a general way to other areas of a similar kind. The report may, therefore, be taken as a type report, of general significance for the conservation and rehabilitation of all our resources throughout Canada. And in evaluating the estimates of costs of the Ganaraska plan, it should be remembered that this would provide for only a small area in need of such treatment. The amount will have to be multiplied many times to take care of all the needy areas of the country.

The report has not been designed solely for the specialist. It does not content itself with facts and figures, but presents the cause and effect of changes in the area in an illuminating way. A liberal number of illustrations supplement the text; in themselves they tell a story of unwise settlement and land use, and the urgent necessity for rehabilitation. It is to be hoped that this contribution to our literature on conservation will bear good fruit, both in stimulating public interest and in developing programmes ready for action.

R. C. Wallace

Queen's University, Kingston, Ontario,
December 21st, 1943.

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MAPS

APPENDIX AND BIBLIOGRAPHY

The Appendix and Bibliography have not been included in the printed Report. It is planned to assemble these in mimeographed form and make them available for distribution at a later date.

SUMMARY OF THE REPORT

Part One—Settlement

1. The Ganaraska Watershed is an area of approximately 103 square miles, in Durham and Northumberland Counties, Ontario, lying north and west of the town of Port Hope. It is drained by the river of the same name, which empties into Lake Ontario at the above town.

2. Settlement commenced about the old Indian village site at the mouth of the river. As early as 1793, loyalists commenced to arrive at this point, and here the town of Port Hope had its beginning. The town has been known by different names; first, those given by the Indians, then Smith's Creek, for a short time Toronto, and from 1819 as Port Hope. Colonization advanced northward from the lake and several villages came into being, which supplied the farming communities. From 1837 to 1881, settlement expanded rapidly. The population of the rural areas, as well as the town of Port Hope, reached a high mark in 1881, which has not since been equalled. During this period there was great activity in lumbering, milling and numerous small industries in the villages. After 1881, due to the near exhaustion of timber and the fact that much of the land in the north was of poor agricultural quality, young people commenced to migrate from the area, with the result that the population decreased and several small communities disappeared altogether, while those remaining are only a skeleton of their former selves.

3. The first land transfers from the Indians to the whites, were made in 1784 and 1788. In 1791 the first land survey was made and the townships along the lake front were laid out. Land grants for settlement followed quickly after the surveys, and by 1860 most of the land had been alienated from the Crown. Early roads for the most part followed old Indian trails, and new roads were projected as settlement advanced northward, some of which, after 1843, were maintained by toll gates. Four railroads have been built in the area, and those serving the district at the present time are the C.N.R. Main Line, the C.N.R. Peterborough Branch, and the C.P.R. Lake Shore Line.

   From the earliest days, the harbour at Port Hope has played an important role in the life of the community, and up to comparatively recent times was the main shipping point for lumber, grain and other produce.

4. Throughout the history of the watershed, the forest has formed a "back drop" for the whole area in all its commercial and community life, commencing with the export of masts for the Royal Navy and squared timber for the British market, down through the several forest products with which we are familiar to-day, such as lumber, shingles, cooperage,

fuel, ties, road materials and fencing. Timber was responsible for many small industries in the villages around which the community life centered. These supplied the farmers with tools, vehicles, building material, furniture and cabinet making. The forest also supplied the early settlers with maple syrup, potash and tanbark.

5. Agriculture in the area followed the same early methods of other parts of southern Ontario. Soil was judged on its ability to grow wheat. The inadequate preparation of the soil for seeding by primitive methods, and no knowledge of the modern methods of rotation, as well as the lack of fertilizer, soon gave rise to the idea that the soils were exhausted. Later on, with the raising of cattle, a marked improvement in soil fertility was brought about. At the present time, agriculture is of the mixed type, with emphasis on dairy cattle, apples, grains, potatoes, and a limited amount of tobacco growing.

6. The watershed is well supplied with springs, most of which take their rise directly or indirectly from the morainic uplands at the north. Snow water and rain, which is impounded in the depressions of this area, sinks into the gravel and sandy soil and appears at lower levels as headwater springs or ground water, which supplies wells lower down the watershed. Of the 289 wells on the whole watershed, 224 are reported as having adequate water supply, 26 reported the supply as being usually adequate, while 38 reported the supply as inadequate.

   The Ganaraska River (21¾ miles in length) is not large in comparison with some other rivers in southern Ontario. It is, more correctly, a group of small rivers and streams which empty into the main river a few miles above the town of Port Hope. Due to the fact that the river rises in hilly country, most of the streams drop very quickly in elevation for the first three or four miles. Also because a large percentage of this part of the watershed is deforested, erosion is severe. As no gauging stations have been established on the river, it is impossible to give accurate figures of the volume of water coming down the river at different times.

   The use of the river for waterpower began in 1795. A total of 45 mills of different types have been in operation on the river, the peak being reached in 1861, with 36 mills in operation.

7. Although soil erosion has been going on since the beginning of time, its control on this continent did not receive serious attention until 1935. Erosion and silting are on the increase. Seventy-five per cent of the silting in the Port Hope harbour is caused by the river carrying soil from the watershed. Dredging has been carried on since 1875, and over 32,000 cubic yards have been taken out in one year. Loss of soil in this way can be controlled by modern methods of agriculture such as contour

plowing, strip cropping, etc., and the proper allocation of land for crops, permanent pasture and woodland.

8. Salmon, speckled trout, sturgeon, passenger pigeons, grouse, beavers, muskrats, raccoons, hares, wolves, deer, bears—all these were found throughout the Ganaraska area before the white man came and the keeping of historical records. To-day, Lake Ontario salmon and passenger pigeons are extinct; the sturgeon fishery, at the river's mouth, is comparatively insignificant; bears are gone; beavers, deer, and wolves are almost locally extinct; speckled trout, grouse and hares are greatly depleted.

Part Two—Surveys

9. The outstanding influence upon the climate in the Ganaraska area is caused by its proximity to Lake Ontario. A very definite moderation, due to the lake influence, is seen in the immediate vicinity of the Lake Ontario shore, while the modification in climate diminishes as one ascends the slopes. On the morainic upland the climate is definitely colder, exhibiting sharper winters and more backward springs than occur on the rest of the drainage area.

10. Soils data is basic to any present or proposed land use problem. The soils map which accompanies the report indicates a broad tract of marginal and submarginal land, approximately 20,000 acres in size, which is recommended for combined forestry and agricultural purposes. Thirteen different soil types and twenty-six series are described, with notes on occurrence, profile, topography, drainage, natural vegetation and agriculture. Soils are also grouped in four classes, on the basis of their suitability for general farm crops such as are usually grown on any mixed farm in this region.

11. The problem of soil erosion on farms in certain parts of Ontario must be faced more systematically in the near future. The problem has been studied thoroughly on a representative area of the Ganaraska. Soils are described and the percentages of the area being eroded are listed. Use capability of different classes is described and suggested cropping practices by the use of special conservation methods are recommended. If erosion is allowed to go unchecked in this area, further reductions in crop yields and universal land abandonment may be expected. Erosion can be controlled, and greater returns can be obtained from the land, if soil-saving and soil-improving measures are carried out.

12. The proposed Ganaraska Forest Area, comprising approximately 20,000 acres, which is the major recommendation of this report, supports 55 farmers and their families, who are located for the most part on poor

soil and are farming extensively, with varying degrees of success. Crop yields for 1940-1942 averaged 13 per cent below the average for the whole Ganaraska Watershed. Total assessed value of all taxable land is estimated at $121,500, with buildings in the same area assessed at $41,611. Average assessed value of land in the Forest Area of Hope Township was $7.70 per acre, and in Clarke Township $4.90 per acre. Live stock sales averaged $468 per farm and were slightly more than 50 per cent of the total revenue from all sources. The average net cash income averaged $459 per farm and $315 per worker in 1940. The yearly cash wage for hired help in Ontario this same year averaged $289. More than 65 per cent of all buildings in the proposed forest area were classed as poor, or poor to fair. On the basis of soil productivity, no soil in the proposed forest area was classed as good, 24.7 per cent was considered fair, 6.5 was poor to fair, and the remainder was poor or waste land. As the size of farm increased, the net returns per farm and per man increased. As crop yields increased, the net cash income and capitalization per farm increased. Sixteen of the 49 farms in the proposed forest area had a net cash income greater than $1,000. Condition of buildings on the farmstead reflected the productivity of the land—the farm with the poorest buildings had yields 20 per cent below average, while farms with the best buildings in the area were only 8 per cent below the average for the watershed.

The average level of living of 33 farmers in the proposed forest area is lower than for the rest of the watershed, and for a good many farms the level is so low that insufficient necessities are obtained, and almost nothing in the way of advancement goods and recreation, which are considered as part of the Canadian level of living.

13. The land use and resources survey on which much of this report is based, was planned to cover each section of each lot on the watershed. The different items listed for study were as follows: cropland, permanent pasture, plantable land, woodland, forest plantations, streams, springs, ponds, wet spots, flooded land, kettle areas, wells, dams, soils, slope, remains of buildings, fences, quality and size of trees in open fields, and on old fence lines, road conditions, vegetation and wildlife. By means of maps, aerial photographs and reports, the above data was gathered and compiled for incorporation into the text of this report.

Land use on the whole area is discussed under Cropland (51.08%), Woodland (23.31%), Plantations (2.53%), Plantable land (18.19%) Severely eroded land (3.23%), and Towns (1.66%).

A total of 718 woodlots were reported on, of which 28.2% are classed as hardwoods, 16.3% as conifers, and 55.5% as mixed stands; the bulk of the area being classed as young stands. Grazing is permitted in 75.6%

of the woodlots. Fires seldom occur. Clear-cutting, especially for fuel wood, is common, particularly in the northern section.

Most of the plantable land consists of the poor soils in the north, with small areas scattered throughout the farms in the south. Erosion is severe on the hills to the north, where also most of the forest plantations are found.

14. A check list of trees and woody plants was made in a representative area of the watershed, chiefly for the purpose of comparing the present flora with changes which may occur as the area is rehabilitated. Observations were also made on the main species of grasses.

    Forest insects were collected to determine the distribution of insect populations, especially those causing serious damage to woodland and young plantations. Recommendations for future management are also outlined.

    Good forest management is reflected in the health of the woods and, conversely, damage by disease is often a sign of mismanagement and neglect. Proper management should be instituted to improve the health of the woodland, and white pine should be encouraged on sites naturally suited to it. Pathological conditions of the whole area are described, with suggestions for improving the stand.

    The river has been the home of speckled trout from early times, although at present they are confined largely to the upper tributaries. Activities looking towards the improvement of the stream for this game fish must consider the maintenance of favourable conditions where they now exist, and the extension of such conditions along those parts of the stream where conditions at present are unfavourable.

15. For carrying out future surveys, it is recommended that an Ontario Conservation Board be appointed, composed of scientifically trained men, within and without the Government, and that full co-operation be given by all Departments of the Government.

16. The most important conservation measure recommended is the establishing of a 20,000 acre forest on marginal and submarginal land at the north of the watershed. Here hundreds of men could be given helpful outdoor work in tree planting, the control of badly eroded areas, thinning and improvement work in existing woodlots, fencing, road building and other types of work incidental to the establishing of a forest property.

17. Throughout the whole watershed, exclusive of the proposed forest and the river protection area, there are small areas of waste land on private farms. Owners should be encouraged to plant these and where areas are too large for individual effort, municipalities should assist. The extension of such work is already provided for by the Government.

Some system of controlled cutting of woodlots should be established. Present cutting is done in a haphazard way, in some areas at least. Some worn-out woodlots might profitably be turned into cropland, but where the woodlot has a direct bearing on conservation, clear-cutting should be stopped.

18. Since the middle of the last century the town of Port Hope has been flooded periodically. Two reports dealing with remedial measures have been prepared by consulting engineers. Their recommendations have to do only with engineering projects in the town, and no consideration is given to the rehabilitation of land at the headwaters of the river, whence a large amount of the water originates. The people of Port Hope should be interested in a scheme of flood prevention which includes the whole watershed.

    Three large dams, with storage for 17,500 acre-feet of water, are indicated for the reduction of floods and the increasing of summer flow. It is also recommended that some of the old dams be rebuilt to impound water for agricultural and wildlife ponds.

19. The main streams and tributaries of the Ganaraska are fairly well protected by woodlots. These should be extended, where necessary. Where farm land bordering the river is subject to top washing, this should be controlled by contour plowing, strip cropping, permanent pasture, and reforestation.

    The Ganaraska area lends itself to the establishment of recreational centres and three such sites are indicated.

    The white pine blister rust should be controlled on certain parts of the watershed by eradicating the alternate host of the disease, namely the botanical family ribes (gooseberries and currants).

    Other remedial measures providing employment are: the improving of streams for fish; forest insect surveys; gathering maple syrup; planting of permanent snow-fences on highways; roadside planting; the collecting of tree seed; nursery practice, and miscellaneous works such as building bridges, culverts, telephone lines, fire towers, camp fireplaces and trails, restoring springs, building forest foot trails, removing old buildings, protecting stream banks, harvesting ice, and erecting historical monuments.

20. Private land owners have carried out remedial work in reforestation. The township of Clarke has established two small demonstration forests, and the United Counties of Northumberland and Durham established a county forest in 1928, in the northern section of the watershed, com-

prising an area of 1,074 acres. Progress made thus far indicates that such methods cannot hope to solve the problem of conservation on the whole area.

Part Four—Administration

21. The only part of the area where large scale purchases of land would have to be made, is on the proposed Ganaraska Forest. Most of this area is classed as marginal or submarginal land, and for the most part should be used for growing timber. The areas of better farm land within the forest could still be used for agricultural purposes. Methods of acquiring land are discussed under transfer by private sale, maximum price per acre, agreements, control by existing legislation, life lease, tax delinquent land, and expropriation.

    Cost of land in the proposed forest is compared with the cost of land now comprising the two county forests established by the United Counties of Northumberland and Durham, within which municipality the Ganaraska area lies. A table of land costs for thirteen county forests in the Province is given. Finally, the cost of land in the proposed forest is computed from the assessed value and placed at $9.25 per acre, or a total of $182,250.00 for the whole forest.

22. The cost of work projects is based on the Civilian Conservation Corps of the United States Government, which at one time had an enrolment of 322,000 men, doing largely conservation work. The equipment and supervision of a unit of 200 men for one year cost $234,500, less an item of $25,000 for equipment, which in the case of the Ganaraska could be supplied by the Army after the war.

    Provision for a supervisory staff of non-technical foremen is provided for by the establishment of a training school.

    After a conservation project is established, provision must also be made for its permanent supervision. The Grand River Valley Conservation Commission in Ontario, and the Muskingum River Conservancy District in Ohio, are described as suggested plans for such supervision. Both projects were started by the people concerned, and legislation has been passed to cover these projects. It is recommended that wider legislation be enacted in Ontario so that any section of the Province, where a conservation problem is acute, may proceed with remedial measures immediately after the preliminary requirements of the Act have been fulfilled.

    Future returns both tangible and intangible are described.

RECOMMENDATIONS

Stated or Implied in this Report

PERTAINING TO LEGISLATION

That:

1—An Ontario Conservation Board be appointed, composed of scientifically trained men from within and without the Government, representing all the sciences, for the purpose of planning and carrying out conservation surveys. Page 189.

2—Legislation be enacted combining the best features of the Grand River Valley Conservation Commission and the Muskingum Watershed Conservancy District, so that municipalities in any part of Ontario may undertake a similar conservation programme. Page 243.

3—Controlled cutting in woodlots on the watershed be inaugurated wherever such woodlots are a part of the general conservation plan. Page 205.

4—A committee be set up in each county for the purpose of reviewing tax delinquent land, so that it may be acquired by the local municipalities for conservation purposes. Page 232.

5—Provision be made for acquiring community pastures and pondage areas. Page 233.

PERTAINING TO EMPLOYMENT

That:

6—Twenty thousand acres of marginal and submarginal land in the northern section of the watershed be withdrawn from agriculture by purchase or expropriation and formed into a protection forest. Page 192.

7—Planting and woodlot management be encouraged in the agricultural area of the watershed, and that post-war employment be used for assistance in this. Page 208.

8—Some of the engineering works recommended in the James, Proctor and Redfern report be carried out to prevent flooding in the Town of Port Hope. Page 211.

9—Adequate water storage ponds be built on the watershed to lessen the possibilities of flooding in the Town of Port Hope. Page 212.

10—Some of the old dams on the Ganaraska River be rebuilt for agricultural and wildlife ponds. Page 214.

11—The land along the Ganaraska River be further protected by reforestation, permanent pastures and contour plowing. Page 215.

12—Special conservation practices are needed on certain classes of agricultural land on the watershed for erosion control and the maintenance of productivity. Page 215.

13—Routine surveys be carried out periodically for enumerating the presence and movement of insects and forest disease. Page 219.

14—The botanical family ribes (gooseberries and currants) the alternate host of the white pine blister rust, be eradicated from certain parts of the watershed. Page 218.

15—Recreational centres be established on suitable areas of the watershed. Page 216.

16—The highways of the area be improved by roadside planting and permanent tree snow-fences. Page 220.

17—A school be established after the war for the training of non-technical conservation supervisors. Page 237.

PERTAINING TO SURVEYS

That:

18—Many more routine conservation surveys be carried out in the Province, for planning a complete conservation programme. Page 190.

19—Surveys should be planned early in the season and aerial photographs taken well in advance. Page 189.

20—A hydrographic survey be made of the important branches of the Ganaraska River. Page 213.

PERTAINING TO RESEARCH

That:

21—Research in each large area to be surveyed be undertaken in hydrologic influences such as stream-flow, ground water, and the depth of wells; and that a weather station be established, if necessary. Page 189.

22—Gauging stations be established on the Ganaraska River to measure volume of flow and amount of silting. Page 214.

23—Studies be undertaken to determine the relationship between deep seepage from the morainic uplands and ground water lower down the watershed. Page 54.

24—Scientific investigations in wildlife habitat be commenced, to properly plan for restocking the area with fish and game. Pages 189 and 100.

25—Studies in ecology be undertaken to ascertain the future effect of proposed remedial measures on the soil and flora of the area. Page 177.

COSTS

MAN HOURS

Woodlot Improvement		672,480
Reforestation:		
Open land planting (conifers)	244,835	
Open land planting (hardwoods)	48,000	
Woodland planting	141,616	
Erosion planting	85,040	
Site clearing	32,000	
Removing interior fences	31,040	
		582,531
Flood Control:		
Storage basins	365,400	
Improvements at Port Hope	200,000	
		565,400
Highway Planting:		
Tree snow fences	132,500	
Tree planting (decorative) on highways	26,400	
		158,900
Wildlife and Other Projects:		
Ponds for wildlife	26,000	
Improving streams for fish	864	
Erosion check dams	5,760	
Boundary fence	24,320	
Road and trail building	3,600	
Fire guards	1,280	
Recreational centres	12,000	
Blister rust control	12,000	
Insect surveys	5,568	
Seed collecting	3,000	
Nursery practice	13,920	
Miscellaneous	15,000	
		123,312
Plantation Improvement:		
Plantation pruning	29,984	
Plantation thinnings	3,504	
		33,488
Total		2,136,111

The above projects provide work for 600 men for 18 months, or two years, leaving out the winter months.

MONEY

It is estimated that 2,136,111 man-hours will provide work for 600 men for approximately two years.

600 men for two years would cost (see pages 222 and 237 for particulars) providing all types of work in the schedule are carried out	$1,200,000.00
Estimated cost of land in Ganaraska Forest	182,250.00
	$1,382,250.00

COMPARATIVE AMOUNTS OF WORK IN MAN-HOURS

Woodlot Improvement—672,480 M.H.

Woodlot improvement would provide the largest amount of work on the watershed. This could be done during all seasons of the year, when the weather is suitable, and would take up the slack when other seasonal projects cannot be carried on. In addition, such work would commence to bring in returns in fuelwood and saw-logs as soon as undertaken.

Reforestation—582,531 M.H.

Reforestation is seasonal and can be carried on only for three or four weeks in the spring, and for the same period in the fall, providing moisture conditions are suitable. Because of this, practically all men on the project would engage in tree planting during these seasons.

Flood Control—565,400 M.H.

Much of the work included in the building of dams would have to be done with the use of heavy machinery and perhaps under contract. In addition, much work would be provided by the clearing out of large pondage areas, including stumping, grading, etc. Such work could be carried on throughout the year, except in the severe winter months.

Highway Planting—158,900 M.H.

This includes the planting of permanent tree snow fences and roadside planting for decorative purposes. Such work is seasonal and can be done only for three or four weeks in the spring and fall.

Wildlife and Other Projects—123,312 M.H.

This group includes the building of wildlife ponds and a number of other types of work indicated in the schedule on the opposite page. All of these, with the exception of seed collecting, can be carried on most of the year.

Plantation Improvement—33,488 M.H.

The pruning and thinning of forest plantations, both privately owned throughout the area and on the large areas contained in the Durham County Forest, could be proceeded with whenever outdoor work is possible.

SPONSORSHIP OF THE REPORT

THE Ganaraska Report was prepared under the joint auspices of the Dominion Government, represented by the Advisory Committee on Reconstruction, which functioned first under the Cabinet Committee on Demobilization and Re-establishment (Hon. Ian Mackenzie, Chairman), later the Privy Council (Rt. Hon. W. L. Mackenzie King, President); and the Government of Ontario, represented by the Interdepartmental Committee on Conservation and Rehabilitation, functioning within the Department of Lands and Forests, first under the Hon. N. O. Hipel, later under the Hon. W. G. Thompson, F. A. MacDougall, Deputy Minister, and E. J. Zavitz, Chief, Division of Reforestation.

The Advisory Committee on Reconstruction was set up in 1941, under the chairmanship of Dr. F. Cyril James, "to examine and discuss the general question of postwar reconstruction, and to make recommendation as to what government facilities should be established to deal with this question." The members of the Committee, additional to the Chairman, were D. G. McKenzie (Chief Commissioner, Board of Grain Commissioners, Winnipeg); J. S. McLean (President, Canada Packers Limited); Tom Moore (President, Trades and Labour Congress), later replaced by Percy R. Bengough (Acting President, Trades and Labour Congress); Dr. Edouard Montpetit (Secretary-General, University of Montreal), later replaced by Arthur Surveyer (Consulting Engineer, Montreal); and Dr. R. C. Wallace (Principal and Vice-Chancellor, Queen's University). Ex officio and consultative members included K. M. Cameron (Chief Engineer, Dominion Department of Public Works); Brig.-General H. F. McDonald* and Walter S. Woods (Chairman and Vice-Chairman respectively of the Advisory Committee on Demobilization and Rehabilitation); and Dr. W. A. Mackintosh (representing the Advisory Committee on Economic Policy). Research Adviser to the Committee was Dr. Leonard C. Marsh (formerly Director of Social Research, McGill University); and Mr. J. E. Mackay was Secretary. The Committee has now completed its reports to the Dominion Government.

One of the subcommittees set up by the Committee on Reconstruction was charged "to consider and recommend . . . the policy and programme appropriate to the most effective conservation and maximum future development of the natural resources of the Dominion of Canada, having regard to the importance of these resources as national assets and emphasizing the part which the proposed policies may play in providing employment opportunities at the end of the present war." This Subcommittee, on Conservation and Development of Natural Resources, functioned under the chairmanship of Dr. R. C. Wallace,

* Deceased


NATURAL RESOURCES
OF THE
GANARASKA WATERSHED
PRESENT AND FUTURE
REFORESTATION
WOODLOTS
MAPLE SYRUP
EROSION DAM
PLANTATION IMPROVEMENT
FIRE TOWER
TREE NURSERY
CAMPING
ELIZABETHVILLE
WINDBREAKS
KENDAL
WATER STORAGE
OSACA
GARDEN HILL
CAMPBELLCROFT
PERRYTOWN
CANTON
HIGHWAY PLANTING
FLOODS
PORT HOPE
NORTHUMBERLAND AND DURHAM
UNITED COUNTIES

and as the most closely concerned with the subject-matter of the Ganaraska Survey, maintained special interest in the development of the report throughout the period of its operation. As another subcommittee was concerned with Agricultural Policy, the Subcommittee on Resources devoted its major attention to mining, forestry, water and power resources, fisheries, wildlife and recreational facilities, but related these to soil conservation where this was appropriate. The membership of the Subcommittee included the following: Dr. R. C. Wallace (Chairman); D. Roy Cameron (Dominion Forester); E. J. Carlyle (Secretary-Treasurer, Canadian Institute of Mining and Metallurgy); J. B. Challies (Vice-President and Executive Engineer, Shawinigan Water and Power Company); Dr. J. D. Detwiler (Department of Zoology, University of Western Ontario; President, Canadian Conservation Association); D. A. Gillies (President, Gillies Bros., Braeside, Ont.); Dr. A. G. Huntsman (Department of Zoology, University of Toronto); Vernon E. Johnson (Manager Woodlands, Canadian International Paper Company); Hoyes Lloyd (Superintendent, Wild Life Protection, National Parks Bureau, Department of Mines and Resources, Ottawa); John McLeish (formerly Director of Mines, Ottawa); Professor Esdras Minville (Ecole des Hautes Etudes Commerciales, Montreal); Dr. J. J. O'Neill (Dean of the Faculty of Engineering, McGill University); and Greig B. Smith (Assistant Director, Commercial Relations, Department of Trade and Commerce, Ottawa).

The Interdepartmental Committee on Conservation and Rehabilitation was appointed in February, 1942, but had its genesis in the meetings of the various groups in Ontario which came later to be known as the Guelph Conference. The organizing meeting of these groups was held at the Ontario Agricultural College on April 25th, 1941, when delegates attended from the Ontario Conservation and Reforestation Association, The Federation of Ontario Naturalists, The Ontario Federation of Anglers and Hunters, The Southern Ontario Section of the Canadian Society of Forest Engineers, The Canadian Society of Technical Agriculturists, The Canadian Conservation Association, The Canadian Legion, The Men of the Trees and The Royal Canadian Institute. It was agreed at this meeting that:

"Present conditions may be fairly summarized by the statement that all the renewable natural resources of the Province are in an unhealthy state. None of these natural resources will restore themselves under present conditions, and the need for far-reaching measures of restoration and conservation is acute; without them conditions will get progressively worse.

"Small measures of restoration and conservation are being taken in most fields, but they are so small as to be insignificant in their effects,

when compared with the magnitude of the need. To be effective, treatment must be province-wide in plan.

"To arrest the degradation of natural resources and to restore in some measure their lost productivity involves replacing the unplanned individualistic exploitation of the past hundred years by planned management based on knowledge and recognizing public as well as private interest.

"Natural resources form a delicately balanced system in which all parts are interdependent, and they cannot be successfully handled piecemeal. The present situation requires the co-ordination of existing relevant knowledge and its amplification where necessary, and then the development of a comprehensive plan for treating the natural resources on a wide public basis."

For the purpose of united action on this programme, the delegates decided that the group representing the various organizations should henceforth be known as the Guelph Conference, and that the needs of conservation in southern Ontario should be set forth in a printed statement. This was subsequently published under the title "Conservation and Post-War Rehabilitation," in February, 1942.

A committee of the Guelph Conference met with the Committee on Reconstruction in Ottawa in August, 1941. At this meeting the purpose of the Guelph Conference was outlined, and the need for a type or demonstration survey discussed. It was agreed that if an appropriate project could be outlined, to be conceived and executed as a special piece of conservation research for general application to Canada, the Committee might request an appropriation to assist with the cost of such a study. The chairman of the Guelph Conference, Mr. J. D. Thomas, discussed the proposals of the Conference with the Prime Minister of Ontario (Hon. Mitchell Hepburn) in December of the same year. Mr. Hepburn gave his support to the project, and later requested the Hon. Mr. Hipel to discuss it in further detail with members of the Conference. Subsequently, the Minister authorized the appointment of the Interdepartmental Committee, with A. H. Richardson (Forest Engineer, Department of Lands and Forests) as full-time Chairman, and with powers to organize the survey. In addition to the chairman, the membership of the Interdepartmental Committee on Conservation and Rehabilitation is as follows: Commander A. W. Baker* (Head of the Department of Entomology, Ontario Agricultural College); Norman Davies (Inspector of Agricultural Classes, Department of Education); Otto Holden (Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario); Dr. M. E. Hurst (Provincial Geologist, Department of Mines); H. H.

* On active service.

Mackay (Director of Fish Culture and Biologist, Department of Game and Fisheries); Dr. J. T. Phair (Chief Medical Officer of Health, Department of Health); and Professor G. N. Ruhnke (Head of the Department of Chemistry, Ontario Agricultural College).

The survey which was finally embarked upon, after preparatory discussions between various members of the committees concerned, was a new departure from any previous work. There have, of course, been many conservation surveys in Ontario and elsewhere, but they have been for such purposes as the segregation of various lands from agricultural land, as a guide for counties in purchasing land for municipal forests, etc. There have also been completed or contemplated, surveys of districts for particular purposes of a scientific or informational character, including some particularly concerned with conservation or reclamation. The special project which was agreed on by the present sponsoring committees, however, was a complete inventory of all the factors affecting the present and future development of all the natural resources within the Ganaraska Watershed area. It was intended to demonstrate conservation needs, survey techniques, and the character of remedial projects; and to provide a yardstick in measuring the exact nature of such projects. To make this possible a pooling of effort on an extensive scale was necessary, as is described in the succeeding pages.

ACKNOWLEDGMENTS

THE wide coverage attempted in this report has been possible only through the contributions of assistance in various forms, and of survey and report material, which were furnished generously and co-operatively from a great many sources. Members of the staffs of departments of both Dominion and Provincial governments, voluntary associations and private citizens interested in conservation or in the region concerned, as well as the staff specially engaged for the work, have all helped to supply the information from which this report has been built up. Such widespread interest has been aroused in the project that a list of everyone who has volunteered aid in one form or another would be long indeed. It is a pleasure to acknowledge at least some of the most material assistance.

The Economics Division of the Dominion Department of Agriculture, Ottawa, gave practical help by fitting in some of their survey plans as closely as possible with those projected for the forestry, land use and other surveys of the Ganaraska area. During the summer of 1942, at the request of the Chairman of the Ontario Interdepartmental Committee, this Division placed a group of field men in Hope and Clarke Townships, for the purpose of conducting a farm economics survey, with special reference to the Ganaraska area. The results of this field work are embodied in the chapter on the Economic Aspects of Agriculture in the region. This survey was under the supervision of Mr. J. Coke, Senior Agricultural Economist, and the report was prepared by B. A. Campbell, assisted by J. N. Lewis in the section dealing with family living expenses. Field work for the survey was conducted by A. Gosselin, B. A. Campbell, E. P. Reid, and J. E. O'Meara. Thanks are also due to Mr. Coke for many helpful suggestions in connection with the field work of the general land use survey, to Dr. J. F. Booth, Chief of the Economics Division, and to Dr. G. S. H. Barton, Deputy Minister of Agriculture.

Another important component of the report is the material on soils of the Ganaraska area. For permission to use and abridge the reports and maps of the Soils of Northumberland and Durham Counties (prepared by the Ontario Agricultural College) and the Soil Erosion and Land Use Survey of the Hope Township Project Area (prepared by

the Dominion Department of Agriculture), thanks are extended to the Soil Survey Committee for Ontario, composed of Dr. G. I. Christie, Professor G. N. Ruhnke, Mr. F. F. Morwick, Mr. L. R. Webber, and Mr. A. L. Willis, of the Ontario Agricultural College, and Dr. E. S. Archibald, Dr. E. S. Hopkins, Dr. A. Leahey, Mr. P. C. Stobbe, Mr. L. E. Wright, Mr. G. A. Hills, and Mr. N. R. Richards of the Dominion Department of Agriculture.

For their active interest and co-operation in all aspects of the forestry phases of the programme, it is desired to tender thanks especially to D. Roy Cameron, Dominion Forester, D. A. Macdonald, Assistant Dominion Forester, and other members of the staff of the Dominion Forest Service of the Department of Mines and Resources, Ottawa.

For the review of forest tree diseases relevant to the area, Dr. W. R. Haddow, Provincial Pathologist of Ontario, took the responsibility and kindly supplied the section on this topic. Similarly a section on forest insects was prepared by Dr. J. J. de Gryse and Mr. K. E. Stewart of the Division of Entomology, Dominion Department of Agriculture, and the section on fish was contributed by Dr. A. G. Huntsman, Professor of Marine Biology, University of Toronto and W. J. K. Harkness, Director of the Ontario Fisheries Research Laboratories.

The historical data on the region was secured through the co-operation of many interested persons, and thanks are extended to Dr. C. T. Currelly, Director of the Royal Ontario Museum of Archaeology, and Dr. C. W. Jefferys, Canadian Historical Painter; Mr. Edwin Wilson of Garden Hill; Mrs. F. A. Wheeler of Elizabethville; Mrs. Wilson, Editor of the Guide, Port Hope; Mr. A. Mark, Town Clerk, Port Hope; and many other persons in the Port Hope region who have so kindly made available valuable books, manuscripts, diaries, documents, newspapers and maps, for research purposes.

Assistance on various points is acknowledged from Mr. A. J. Connor, of the Meteorological Division, Department of Transport, Toronto; Mr. L. J. Chapman, Research Fellow, Ontario Research Foundation; Professor J. R. Dymond, and Mr. L. L. Snyder of the Royal Ontario Museum of Zoology; Mr. H. H. Mackay, Director of Fish Culture and Biology, Ontario Department of Game and Fisheries; Professor A. F. Coventry, Department of Zoology, University of Toronto; Dr. H. B. Sifton, Department of Botany, University of Toronto; Mr. Otto Holden, Chief Hydraulic Engineer, and John Mackintosh, of the Hydro-Electric Power Commission of Ontario; Professor G. N. Ruhnke-Head of the Department of Chemistry and Director of Soil Surveys, Ontario Agricul, tural College, Guelph; Professor W. M. Drummond, formerly Head of the Department of Agricultural Economics, Ontario Agricultural College, Guelph; C. H. Fullerton, Chief, Division of Surveys, Department of Lands and Forests; R. N. Johnston, Chief, Aerial Surveys Division, Department of Lands and Forests; E. A. Summers, Agricultural Representative for Durham County; G. M. Linton, Superintendent, Orono Nursery, Department of Lands and Forests; and Albert Stewart, Caretaker of Durham Forest.

Appreciation is also extended to the members of the staff engaged specially for this project; particularly to Miss Muriel Miller, who undertook most of the research work for the chapters on Historical Background and Wildlife, and prepared much of the material on these subjects for the final revision; to Mr. V. B. Blake of Garden Hill, data on the historical background of the area, especially mills and dam sites, roads and settlement; to L. Laking and A. R. A. Taylor, members of the field staff, who were responsible for the section on Vegetation; to the two draughtsmen, Mrs. R. O. Secord and Miss H. M. Kippax, who were responsible for the maps of the watershed, assisted by A. S. Crawford of the Aerial Surveys; to the members of the field staff, especially the Forester, Mr. L. F. Greer, and the Camp Supervisor, Captain V. Lowens. Thanks are also extended to my Secretary, Mrs. H. M. Gregory, for the splendid co-operation given in all phases of the work.

To simplify the discharge of the tasks involved in co-ordinating the extensive material available, and preparing the final text of the original typewritten report for publication, the necessary editorial powers were assigned by the two Committees to Dr. L. C. Marsh (Research Adviser, Committee on Reconstruction) and the undersigned, acting for the Dominion and Ontario governments respectively.

A. H. RICHARDSON.

Toronto, December 21st, 1943.

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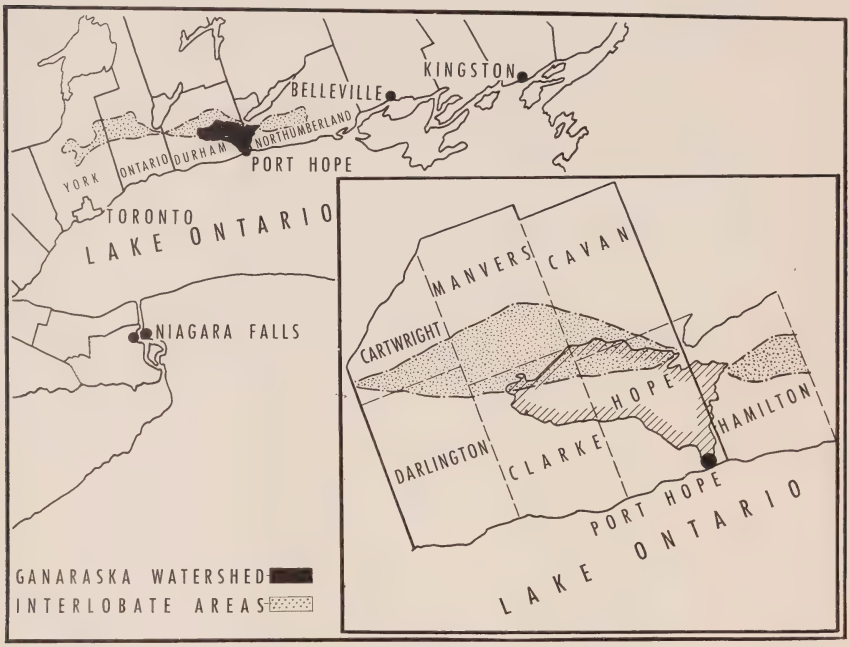
SETTLEMENT

"The land is wearing an ill-fitting agricultural garment, too long unchanged"

CHAPTER ONE

Location and Boundaries

THE Ganaraska Watershed is an irregular funnel-shaped area of approximately 103 square miles extending, at its widest part, east and west through Durham County and a smaller part of Northumberland County, in the Province of Ontario, and narrowing sharply at its base, or spout, at the Town of Port Hope where the river, from which the area takes its name, empties into Lake Ontario.



The total amount of usable land on the Ganaraska, not including roads, some of the smaller municipalities, and the town of Port Hope, is 65,911 acres. Of this total, 39,947 acres, or 60.60 per cent of the area is in Hope Township; 20,060 acres, or 30.44 percent, in the Township of Clarke; 4,434 acres, or 6.73 percent, in the Township of Hamilton; and 1,470 acres, or 2.23 percent, in the Township of Cavan. At its widest part, from east to west, the watershed extends for eighteen miles (cutting 70 lots) and the distance from its most northerly point to Lake Ontario is thirteen and three-quarter miles.

A watershed has been defined as high ground separating two river systems. Taken in this literal, and not commonly used sense, it becomes only a boundary line, but in this report, the term is used in the broader sense to describe an area which is drained by a river and its tributaries. In this report, also, the terms watershed, drainage area, drainage basin, and drainage unit are used interchangeably. The Ganaraska Watershed, then, includes the land area feeding the river system, both by surface drainage and by deep seepage.

This broader meaning of the term is justified in the case of the Ganaraska because of the presence of an upland area which occupies the highest part of the terrain and divides the flow of water in this section of the province. This height of land, sometimes called a knob and kettle area or a pot-hole area, may also be called a morainic upland. This term will be used in this report.

The morainic upland has no permanent outlets for streams or creeks, the water absorption being effected by deep seepage through the gravel, thus feeding springs and wells at lower elevations. In a broad sense, therefore--and considering the definition that a watershed includes all sources of water supply--parts of this upland area could logically be distributed between the watersheds which draw moisture from the area. Furthermore, the inclusion of a part of this area, in the case of the Ganaraska, is desirable because the morainic upland includes submarginal lands with respect to agriculture which, in the event of future development, should be managed with similar areas lower down the slope. For these reasons, therefore, that part of the morainic upland from the watershed boundary proper to the northern boundary of Clarke Township has been included in the survey and is dealt with, in this report, as an integral part of the watershed.

The boundaries of the watershed were located primarily by a careful examination of the contour lines on the Military Map. After these lines were tentatively drawn, they were checked by examining the drainage, as shown on the aerial photographs, with a stereoscope. In some cases the boundaries were further checked on the ground. In the case of that section of the morainic upland included in the watershed, an arbitrary line was drawn following the northern boundary of Clarke Township on the north, and a small part of the Newcastle-Pontypool road on the west.

CHAPTER TWO

Town, Village and Rural Communities

1. INDIAN AND FRENCH PERIODS

[a] The Indian Period:

IT was at the mouths of North American rivers that the red man congregated on his carrying-places and that settlements grew up; it was at the mouths of rivers that the white man usually landed and colonization began. This was true in the case of the Ganaraska.

In the days of the unwritten past, one tribe of Indians seems to have superseded another on the Ganaraska—an area of densely wooded country with varied forest growth and rolling terrain cut by multifold valleys through which the river and its tributaries flowed.

Although the discovery of a fulsom point[1] at Rice Lake, dating from this era, indicates that Indians hunted intermittently not far from the area, evidence points to the fact that hunting in primitive times was more sporadic here than in certain other areas in Ontario.

Coming across the centuries to modern times, the earliest record of any tribe having access to this region is of the Huron which was in possession of the hunting, trapping and fishing on the north shore of Lake Ontario by the early seventeenth century.

How early in the history of the continent the secluded valley of the Ganaraska was explored by the white man cannot definitely be stated, but, prior to 1639 when the Iroquois commenced a series of raids on the Hurons, it is recorded that: "They almost destroyed the Huron Mission and rendered life so unsafe along the north shore of the lake that it was almost deserted for many years."[2]

From the days of Champlain the Ottawa route "had been the only available approach to the interior."[3] States C. W. Jefferys, Canadian historical painter, "Owing to the menace of the Iroquois along the St. Lawrence and Lake Ontario, except for short intervals of truce, the only safe route to the Huron country and the west was up the Ottawa River,

[1] Fulsom point (stone arrow head) in the Royal Ontario Museum of Archaeology, Toronto.

[2] "Notes on the History of Port Hope"—H. R. S. Ryan, Port Hope.

[3] "Toronto During the French Regime"—Percy J. Robinson.

and by way of Lake Nipissing, French River and Georgian Bay. Champlain, in 1615, took this route to Huronia. When later in the same year he accompanied his Huron allies in their expedition against the Iroquois country at the south-east of Lake Ontario, he travelled from Lake Simcoe by the Trent valley route. On his return to Huronia, he followed the same way. Thus he twice skirted the northern boundary of the Ganaraska region, evidently without ever having penetrated it." It is, thus, highly improbable that the early French explorers, or even the French, English and Dutch traders prior to the Iroquois conquest, had discovered the Ganaraska-Rice Lake carrying-route.

The Iroquois did not immediately settle in the area even when, in 1650, "the miserable remnant of the Hurons fled northward along the western shore of Georgian Bay."[1] They did, however, use the north shore extensively as fishing, hunting and trapping grounds from which they gathered the rich furs for the English and Dutch on the Hudson.

[b] The French Period:

Shortly after Canada had become a Royal Province of France in 1663, it seems that the French began to "find their way to Lake Ontario, to explore its shores and to lay their plans for recapturing from the Iroquois the fur-trade."[2] The Iroquois were almost continually at war with the French although, with the coming of the Carignan-Salieres regiment from France in 1665, some degree of peace was achieved.

At the time of the Iroquois victory, the north shore of the lake, "once so thickly peopled by the Hurons, the Petuns, and the Neutrals"[3] had been desolated; but by 1666, the Iroquois "had established themselves where the trails led off into the interior."[4] "Beginning at the eastern end of Lake Ontario"[5] it is recorded that Ganneious, Kenté, Kentsio, and Ganaraské had been established—these being "villages of the Cayugas who had fled from the menace of the Andastes to a securer position beyond the lakes."[6]

In 1668 "the Sulpicians of Montreal began their mission"[7] to these "scattered Iroquois on the north shore of Lake Ontario";[8] and it was they who rounded up the envoys for the Governor when Frontenac, after having founded his fort at Cataraqui (Kingston) in 1673, called together "the deputies of Ganatseqwyagon, Ganaraské, Kenté, and Ganneious."[9] On the French map of 1673, the settlement of Ganaraské is placed on the north shore of the lake near the mouth of a river which is

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[1, 2, 3, 4, 5, 6, 8] "Toronto During the French Regime"—Percy J. Robinson.
[7] "Notes on the History of Port Hope"—H. R. S. Ryan.
[9] French Map of 1673.

in correct relation to Rice Lake for the present Ganaraska. This must have been near the site of the present town of Port Hope and it was marked as one of the "*villages de Iroquois dont quantite s'habituent de ce coste depuis peu.*"[1]

How early in the years of French rule a ship's sail gleamed in the natural harbour of the Ganaraska cannot definitely be stated. It is doubtful whether La Salle himself reached this area, although the early *coureur des bois* did, no doubt, skirt the shore and may have stopped more or less permanently in this area. Exactly when the Cayugas abandoned Ganaraské cannot be judged either, but, sometime within the next generation or two "a race . . . referred to as Mississagues in the proclamations of our Governor"[2] settled at this point. These Indians belonged to the Algonkian family, "who were less advanced in civilization than the nations of Huron and Iroquois,"[3] the latter being "more closely related to each other than they were to the Algonquin."[4]

The Mississauga settlement, located on the east bank of the river, was known as Cochingomink which is said to mean "the commencement of the carrying-place,"[5] and, certainly by the early eighteenth century, the Indian portage or carrying-route from the lower waters of the Ganaraska to Rice Lake was the principal approach to the interior in this vicinity.

During the last fifty years of French rule in Canada, trapping, hunting and fishing were continued by the scattered and more or less migrant inhabitants ranging the watershed of the Ganaraska. At least three other Indian posts seem to have been established within the drainage area: the first on the old carrying-route "at about the present Dale cross-roads;"[6] the second in Hope Township, at Doneycroft,[7] Lot 14, Concession IV, and the third on the south end of Lot 20,[8] Concession VII of Hope. These settlements and the more permanent village at the mouth of the river seem to have been the only Indian communities on the Ganaraska during the years when Canada was a part of the great French colonial empire.

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[1] "villages of Iroquois of whom numbers have been dwelling on this shore for a short time."

[2, 3, 4, 6] "Notes on the History of Port Hope"—H. R. S. Ryan.

[5] Port Hope Historical Sketches, 1778-1901—W. Arnot Craick.

[7] Campfire remains (stone circles) were found in the soil of C. T. Currelly's garden at Doneycroft, as well as a stone hammer—an instrument used by the Indian for making arrow heads—and an adse for digging out canoes or sap troughs or buckets.

[8] "Reid Wilson's father used to send them over with a basket to gather relics whenever they (the Gardiners) plowed that piece"—Edwin Wilson, Nov. 6th, 1942. "It must have been a burying ground."

2. A PRIMITIVE ECONOMY (1759-1834)

[a] The Village of Port Hope:

With the Treaty of Paris in 1763 Canada became a British Crown Colony. Shortly after this, in 1775, the American Revolution broke out, following which there was an influx of loyalists to Canada. Some of these, it is presumed, commenced trading in the area, as authenticated by an early record in the Transactions of the Canadian Institute, for, on the twenty-second of October, 1878, the following citation occurs: "Trading houses existed for some years between 1770 and 1780 at Pinewood Creek and Piminiscotyan Landing on the north shore of Lake Ontario."[1]

A more specific reference to the early traders in this area is found in the Report of the Land Committee, where it states that: "Richard Beasely and Peter Smith, loyalists, pray for land at Toronto and at Pemitiscutiank, a place on the north shore of Lake Ontario, having already built a house at each of these places, and they petition for as many acres around each as is the usual allowance made to loyalists."[2]

Piminiscotyan Landing, Pemitiscutiank, and its variations Pematash Wotiang Landing and Pematask-watiang, have all been identified as the settlement at the mouth of the Ganaraska River. By 1780 it had taken its English name from the trading-post established by Peter Smyth and was called Smith's Creek.

It was not, however, until after 1788 that the British had right of access to the whole Ganaraska area. History records that: "On November 13, 1763, Sir William Johnson wrote to the Lords of Trade that the Five Nations claimed possession of Ontario, including the Mississauga country,"[3] and not until after the Indian treaty of 1788 was the land on the west bank of the Ganaraska available to the white settler.

It was the Constitutional Act in 1791, however, which gave the first real impetus to pioneering. The newly elected Legislative Assembly of Upper Canada—convening at its first session in 1792, was more active than former administrations and showed greater disposition to help settlers than had previous ones.

By October, 1792, Elias Smith, a U.E.L. merchant—who, by coincidence, had the same surname as the trader from whom the settlement took its name—and Captain Jonathan and Abraham Walton sailed

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[1] "Transactions of the Canadian Institute," 1892-93, page 201, General Ernest Cruickshank.

[2] "Toronto During the French Regime,"—Percy J. Robinson.

[3] New York Colonial Documents, Vol. V, p. 1056.

as far west as the mouth of the Ganaraska and in 1793 they began engaging loyalists to settle in Hope Township. To quote from a letter written by Smith to Governor Simcoe: "Myself, with Captain Walton, brought in the country four families consisting of twenty seven Souls the 7th June, 1793, not a single family nearer on the one side of them than 60 miles on the other side 50 miles and all those people we have furnished with provision for the first year. We have an Order of Council for the Township of Hope we settled the familys on."

In 1790, Peter Smyth retired from active fur-trading and turned over his trading-post to Herchimer,[1] also considered to have been a loyalist, and, when the pioneers arrived in early June, 1793, Herchimer was the trader in this settlement of three hundred Mississauga Indians. The settlers arriving at the mouth of the Ganaraska were Myndert Harris, the elder, Laurence Johnson, Nathaniel Ashford, James Stevens, and their families. According to a description of the arrival, authenticated by Myndert Harris, the younger: "On the 8th of June . . . our pioneers were landed, the men carrying their wives and children ashore, through the foaming surf that surged upon the beach. . . . They found the place a regular Indian village, thickly studded with wigwams and bearing the name of Cochingomink. The Indians were so startled by the unexpected approach of the pale-faces that they upbraided the latter, and denounced them as Yankee intruders, but when Mr. Herchimer explained that they were not Yankees, but children of the Great Father, the King of England, the red men became appeased, and welcomed the strangers cordially. The party reposed for the night under their tents, and in the morning began the erection of log huts, thatched with bark, on the east side of the creek. . . . They named the place the 'Flats'—a designation which it retained for a length of time."[2]

Between the years 1793 and 1797, Smith and Walton—the founders of the township—settled forty families thereon and, by Order-in-Council of the eighth of October, 1797, they were given a Crown Patent for lots five, six and seven of the Broken Front and Concession I of Hope Township—this being the site of the present town of Port Hope. It was with this grant that the settlement became definitely established, took the name of Smith's Creek and village life began.

The economy of the village was agricultural, each family growing or making practically all the necessities of life. There was, however, even in the earliest years of settlement some commercial life and some import trade from the United States, although most of the supplies came through the port of Montreal. The sailing ships which plied the lake anchored

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[1]Lawrence Herchimer is described as the partner of Peter Smyth in the Provincial Archives Acts of the Eighteenth Century, 1779-1810.

[2]*Port Hope Guide*, 25 February, 1870.

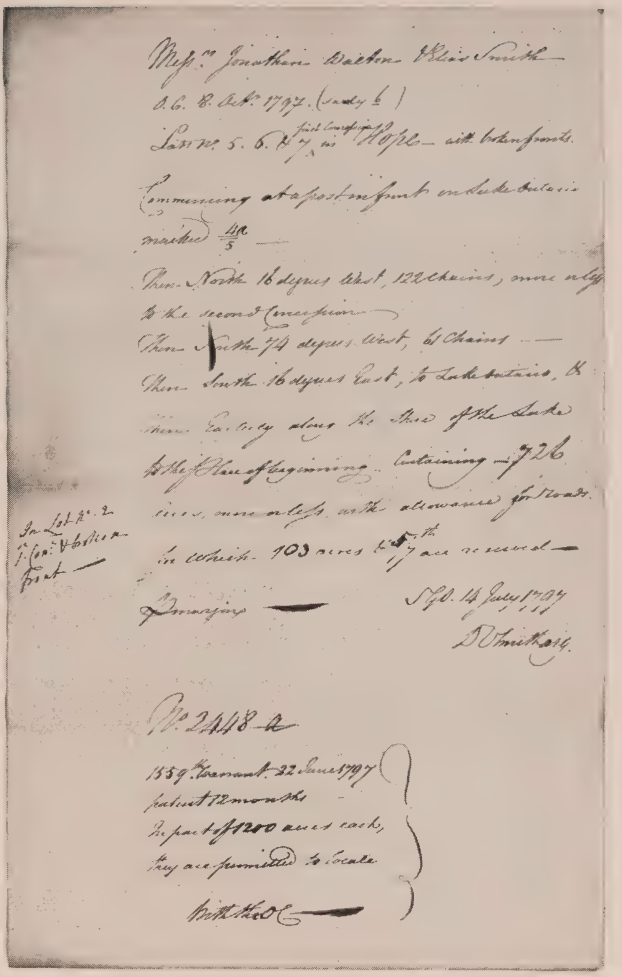
Messrs. Jonathan Walton and Elias Smith, O.C., 8 Oct., 1797 (surely 6). Lots No. 5, 6 & 7, first concession in Hope with broken fronts. Commencing at a post in front on Lake Ontario marked $\frac{4R.}{5}$ Then North 16 degrees West, 122 chains, more or less, to the second concession. Then South 74 degrees West, 61 chains. Then South 16 degrees East, to Lake Ontario, then easterly along the shore of the Lake to the place of beginning. Containing—726 acres more or less, with allowance for roads for which 103 acres & 5/7th are reserved per margin—In lot No. 2, 1st Conc. & broken front.

S.G.O. 14 July, 1797
D. W. Smith, A.S.G.

No. 2448-A

1559th Warrant, 22 June, 1797, patent 12 months—
In part of 1,200 acres each, they are permitted to locate.

With the O.C.

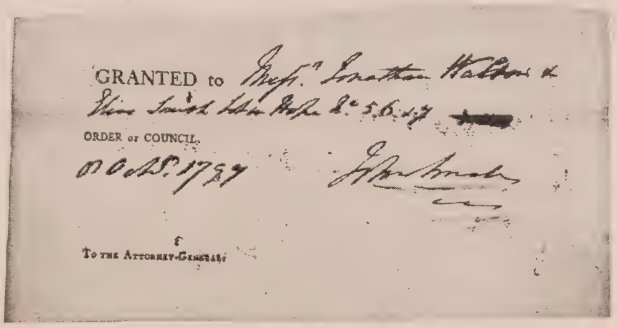


Messrs. Jonathan Walton & Elias Smith
O.C. 8 Oct. 1797. (surely 6)
Lots No. 5. 6. & 7 first Concession Hope — with broken fronts.
Commencing at a post in front on Lake Ontario marked $\frac{4R}{5}$
Then North 16 degrees West, 122 chains, more or less to the second Concession
Then South 74 degrees West, 61 Chains —
Then South 16 degrees East, to Lake Ontario, &
Then Easterly along the Shore of the Lake
to the Place of beginning — Containing — 726
acres, more or less, with allowance for roads.
In which 103 acres & 5/7th are reserved —
Remarks —
S.G.O. 14 July 1797
D. Smith A.G.
No. 2448-a
1559 Warrant 22 June 1797
patent 12 months
In part of 1200 acres each,
they are permitted to locate
With the O.C.
In Lot No. 2
1st Con. Hope
front

GRANTED to Messrs. Jonathan Walton & Elias Smith Lots in Hope No. 5, 6 & 7.
Order of Council,
8 October, 1797.

JOHN SMALL,
C.E.C.

To the
Attorney-General.



GRANTED to Messrs. Jonathan Walton &
Elias Smith Lots in Hope No. 5. 6. & 7
ORDER OF COUNCIL.
8 OCTR. 1797
To the Attorney-General.

Courtesy Department of Public Records and Archives.

Description and warrant, with transcription, of land now occupied by the Town of Port Hope.

off-shore and small tenders or flat bottomed boats went to shipboard, taking off passengers and supplies. Also, in 1793, Elias Smith sent his son, Peter, and a young man, named Collins, from Montreal to the settlement with a supply of goods and instructions to open a store.

The commercial part of the village lay in the valley not far back from the lake and stretched on both sides of the river. Within the first decade after its founding, Smith's Creek had a saw and grist mill, a store, a tannery, a blacksmith shop, an hotel, a distillery, and a tavern in addition to Herchimer's trading-post which had been taken over by Myndert Harris in the autumn of 1793.

The first school—a private enterprise—had been opened in the Smith homestead at the foot of the present King Street, and was taught by Collins in 1798; but the privately run school of John Farley is considered to have been the parent of the public school system of Port Hope, since the log school-house in which the classes were held had been publicly built and the scale of fees to be paid settled at meetings of free-holders in the neighbourhood. The first church meetings were held in the open or in the log houses of the settlers, and, by 1812, the village had a town hall as well as a school-house.

By 1817, the population of the village—as recorded by W. Arnot Craick—was seven hundred and fifty; and, between 1817 and 1826, it showed a marked growth. In the former year a post office was established with Charles Fothergill as the first regularly appointed postmaster. Although the post office carried the name "Smith's Creek", previous to this time the name had fallen into disuse in legal conveyances and that of Toronto substituted. In 1819, to clear this name-confusion,[1] a village meeting was called and the name Port Hope was unanimously accepted.

The commercial life of the village had grown appreciably during the first quarter of the new century and, by 1826, Port Hope had four general stores; two saw and grist mills; four distilleries; one malt house; three blacksmith shops; an ashery;[2] a wool-carding factory; a rush chair-bottom factory; a cut-nail works; a tannery; a fanning mill factory; a shoemaker's shop; an hotel; three taverns; a butcher shop; a tailor shop; a watchmaker's shop; a hatter's shop; and an auctioneer's store.

Community life had also been developing rapidly and several private schools had been opened. Between 1818 and 1822, the first church—St. John's Anglican—was erected on the crest of the eastern ridge which

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[1]Port Hope was called "The Creek" by country people as late as 1837, evidence, Mrs. Moodie. Also "Sodom" was the name applied to it in the '20's and '30's, as is recorded by Anson Green, D.D., in his autobiography.

[2]A place where lye was leached for the making of soft soap.

Walton Street, Port Hope, 1833. From an original water-colour by Sier, reproduced by kind permission of J. S. Smart.

became known about this time as Protestant Hill. Even at this time the movement of population from the valley to the spurs of the hills to the east, north-west and west of the river was noticeable; residences being built on the higher ground, especially in English Town, and on Ward's Hill.

Stage coach service was inaugurated about 1826 and with the establishment of the first newspaper in the village, the *Port Hope Telegraph*[1]—published by John Vail in 1830—Port Hope may be said to have passed the stage of the rural community. In 1834, it was incorporated by act of the Legislative Assembly, its town limits defined and its name given official recognition.

[b] Rural Communities.

Colonization on the Ganaraska Watershed followed rapidly after the founding of Port Hope and by the beginning of the nineteenth century at least three communities had been established north of the town. These were the villages of Dale, Welcome and Rossmount.

It seems that, from the earliest date of settlement, the villages in Hope Township were more or less dependent upon Port Hope itself, although it was not long before residents of these began to specialize in one or another of the trades necessary to life in the rural community. Moreover, British trained artisans, skilled in different trades, were attracted to the villages and it was thus that by the early eighteen

[1] *The Port Hope Telegraph* was taken over by John Furby, British printer and cabinet maker, in 1831, and from this time until 1875 Furby continued to publish weekly and daily newspapers in the town.

hundreds, Dale and Welcome at least had grown into communities of from seven to ten families each.

DALE: The pioneers of this district were James Stevens and Jonathan and Paul Bedford. These three yoemen,[1] with their families, began clearing and working the land in 1798 and 1799. By the time the second wave of settlement reached the watershed and from 1815 to 1820, other families had established themselves in the area and during this half decade, the first industry was commenced. Johaida Boyce, in 1818 and 1819, built a sawmill on the Ganaraska, within half a mile of the village. Thereafter it grew steadily until by 1837 the country around the village was generally opened and under cultivation.

WELCOME: Daniel Crippen, yeoman, was the original homesteader in this area. In 1797, under the Nominees of the Township, Crippen was given an original Crown Patent; while, in the following year, Leonard Soper received a military grant. Between 1805 and 1810 other families moved to Welcome, but it was with the second rush of colonization, around 1815, that the village really became generally settled.

Although Welcome does not, in the early decades, seem to have had a mill in its vicinity, it had the first waggon shop on the river north of Port Hope. This was built by John Westlake in 1830. By 1837 Welcome had a tavern at which the stage coach horses were changed, and was one of the most thriving farming communities in the district.

ROSSMOUNT: Settlement, spreading from the lake front, reached as far north as the sixth concession by 1798, and the village of Rossmount (formerly Lancaster) grew up on the boundary between Durham and Northumberland Counties. Its first settler was Cornelius Daily, a yeoman, who received military lands in 1798; while, two years later, Elizabeth Summers, as the daughter of a U. E. Loyalist, was given an original grant. It was half way to Bloomfield (Bailieboro) and about an hour out of Port Hope with a good trotter. No industries seem to have developed in Rossmount and it was soon outstripped by other communities which started up along the river.

CANTON: As early as 1801, log houses had been built on the Canton site. Centrally located in the fourth concession, it was settled when members of the families of Myndert Harris, James Hawkins and Asa Callender moved there from Port Hope. By 1810, a sprawling community had begun to develop, and there was a marked growth at the time of the war of 1812.

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[1] William Cobbet, Tory Radical, in 1821, says: "Those only who rent are, properly speaking, farmers. Word farmer comes from the French *fermier* and signifies renter. Those who till their own land are yeomen; and when I was a boy, it was the common practice to call the former farmers and the latter yeoman-farmers." As late as 1928 the term was still in use as a juror in the Currie libel suit, Port Hope, described himself as a yeoman.

The village site seems, particularly, to have attracted millers and sawyers because of its excellent water privileges, it being situated at the mouth of the main branch of the river—the North Ganaraska—which is almost of equal size with the main Ganaraska itself. The first mill to be erected was that built by Potter in 1825 although, between 1822 and 1824, three other milling families had located on farms in this part of the watershed. After 1830, three more millwrights and carpenters came to the district and the first grist mill to have been built north of Choate's Pond was that on the Potter site at Canton. It was the forerunner of the present Durham Mills and was completed by 1835.

Quay's: The original grant of land in this vicinity had been made to Elias Smith the younger, in 1798, but it appears that it remained in its wild state until 1816 when John Perry and John Farley, yeomen, got transfers of the land and settled thereon. By 1820, other settlers followed, among whom were Thomas Quay from whom the community took its name.

Although the fifth concession line seems to have been the most northerly point of village settlement in Hope Township before 1820, the decades of the 'twenties and 'thirties saw great changes taking place between the fifth and the eighth concession lines. And, by 1825, hamlets were taking shape in the vicinity of Osaca, Perrytown, Garden Hill and Elizabethville.

Osaca: During the immigration of the 'twenties and early 'thirties, several families moved to Osaca—the earliest settlers of the village being considered to be James Elliott, Robert Watson and William Goslin.

In coming to this area, the pioneers travelled northward from Orono in Clarke, followed up the township line to Concession V of Hope, and cut across to the twenty-eighth lot. The community, however, was not compactly settled and would not have been considered a village in the pioneer period. It had no industries or businesses in this era, and was dependent upon other villages for its supplies.

Perrytown: On the other hand, quite a settlement had grown up by the early 'twenties on the West Gravel and seventh concession line. This site had been originally leased as a Clergy Reserve to Thomas Turner Orton in 1797, but it was John Perry (from whom the village takes its name) and Samuel Caldwell, who are considered to have been the pioneers of the district.

About the same time, Asa Callender, Robert Corbett, Aaron and Nathan Choate, and James Rutledge, settled here; while in 1821 Alexander and Archibald Morrow received land, as did W. S. Gordonier in 1826 and Alexander Ross in 1829. Thereafter, Perrytown developed and settlement spread towards Garden Hill.

Garden Hill: Garden Hill itself did not come into being during the pioneer period, but by 1830 there was an appreciable settlement a little east of the present Garden Hill. The community was called Adams's Corners and there was a toll gate on the West Gravel at this point at a later date. Waterpower was the incentive which brought settlers to this area. The family of Kilpatrick seems to have arrived from England in the 'twenties and to have settled in the area by the 'thirties. While there is no definite evidence when the Kilpatrick mill was built at Garden Hill it changed hands in 1841, so would be presumed to have been in operation in the 'thirties.

Elizabethville: As in the case of Garden Hill, Elizabethville, on the Little Ganaraska, came into being because of its waterpower facilities. The pioneer of the area was Francis Tamblyn who came from England to this district in 1830, followed by three families of relatives who arrived in 1832. These were Thomas Oke, John Barkwell, and a family by the name of Hall. Shortly after the settlement of these families, newcomers arrived including John McMurtry and his wife, Elizabeth, after whom the village in 1840 took its permanent name. No mills or other industries seem to have been opened here in the 'thirties. The residents of the community, after the initial trip from Port Hope up the West Gravel, used the Clarke-Hope township line and made Orono and Bowmanville their market towns. By 1837, there was an appreciable settlement here and the men gathered in the village during the Rebellion of 1837 before marching to Port Hope to join the government troops against the insurgents.

3. EXPANSION AND DEVELOPMENT (1837-1881)

After the rebellion of 1837 and subsequent legislation, an influx of settlers into Upper Canada occurred. By this time, an era of expansion and development had been ushered in and rapid growth in village and town continued up to the eighteen eighties.

Unprecedented progress marked both Port Hope and the villages on the river between 1840 and 1850, and the population of the combined Township of Hope and the town of Port Hope doubled during this decade. From 4,000 for township and town in 1842, the figure rose to 4,600 in 1851 for the township alone, while for Port Hope itself, it was 2,300.

Generally speaking, during the period Port Hope jumped from a relatively pioneer community to an industrial centre, and the rural settlements on the watershed became the pivots about which revolved a progressive agricultural economy. During this period the output of the smithy—direct ancestor of the foundry—became more diversified; and it was at this time, also, that shingle mills, stave factories, waggon

and carriage shops, cooperages, tanneries, fanning and carding mills, grist and woollen mills, and glue and candle factories began to play a vital part in the community. The export of large quantities of big timber and agricultural products, however, was the most important source of revenue within the drainage area.

[a] Port Hope:

Up to and during the eighteen-thirties, the principal source of revenue in Port Hope was its distilleries and its lumber trade—the larger proportion of its exports having been shipped to Britain through the port of Montreal. By the 'forties, however, the whiskey trade had fallen off and, in its place, was more direct grain export to Britain and to the United States. The lumber business increased steadily from year to year and new mills were opened, while the town became the market town for the agricultural lands lying on the lower reaches of the river.

Particularly, too, did the flour and the woollen mill business grow during these years. With the 'forties, as well, new industries in the town were opened to supply both town and villages with implements and conveyances. In 1842, Robert Chalk opened a carriage factory which supplied the local market.

In the sphere of municipal affairs, the 'forties brought considerable change; for, in 1849, a new system of town government was inaugurated in Port Hope. Up until this time (from the year of its incorporation in 1834) it had been ruled by a Board of Police which met at the Exchange Coffee House on the site where the Queen's Hotel now stands. With the passing of the Municipal Institutions Act, however, a board of councillors was elected to replace the Board of Police, and from these councillors a mayor was selected.

In 1853, also, came the building of the Town Hall—the first permanent municipal building since the early log building of 1812 –and during this decade there were at least four papers, principally weeklies, being published in Port Hope. In 1857, the first public utility was organized—the Port Hope Gas Company—in which the town took £2,500 stock.

An event of outstanding importance over the entire watershed occurred in the 'fifties. The arrival of the "iron horse" as it was termed, marked the real opening of the industrial era and revolutionized commercial life on the Ganaraska more than any other single occurrence to date. In 1852, Hope Township took £15,000 stock in the Port Hope, Peterborough and Lindsay Railway Company, later called the Midland and Millbrook Branch.

Port Hope, after the building of the railroads, became more than ever the market town for the newly opened country to the north. Domestic

output in practically every line of industry leapt during the 'fifties and 'sixties. In 1860, the corporation withdrew from the United Counties, and its population, estimated at 2,300 in 1851, had jumped to 4,162 in 1861 and to 4,500 in 1865-67.

Apart from railroad construction and industrial expansion in the 'fifties and 'sixties, a great many harbour improvements had been made, but facilities were still inadequate. However, in 1867, the contract for the new harbour construction was let and the Dominion Government, at a cost of upwards of a quarter of a million dollars, built the Port Hope west pier and docks.

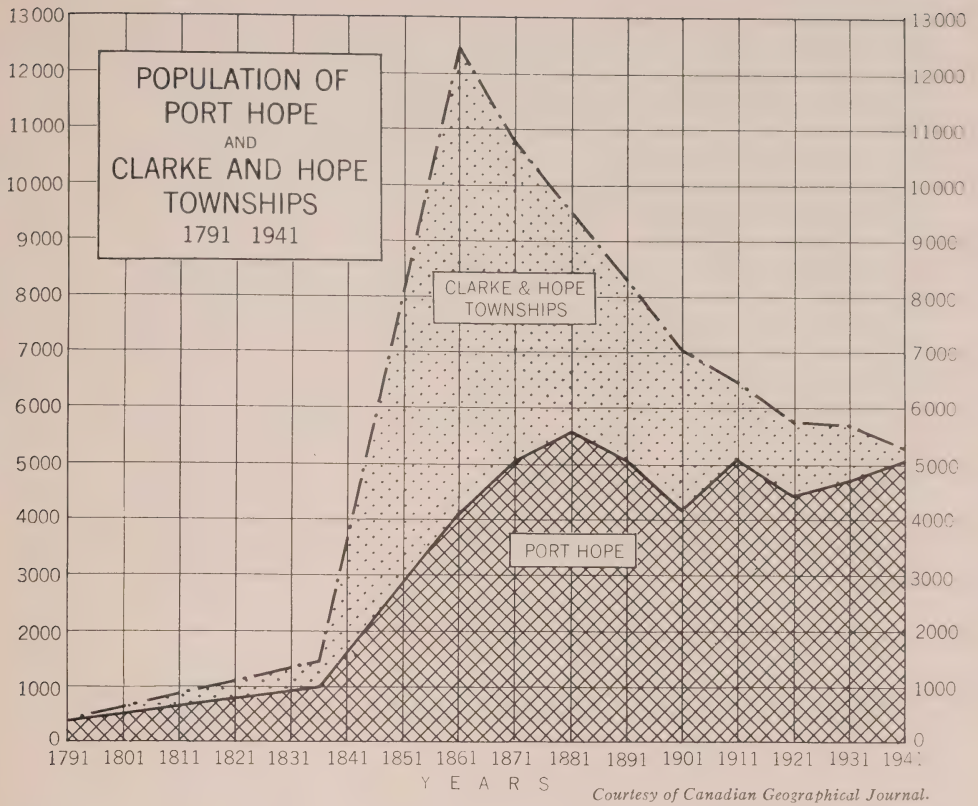
During the remainder of the 'sixties and the 'seventies, the town continued to expand and to grow more prosperous. The boom occasioned by the harbour building and the railway construction continued, and shipment of lumber and of grain—the chief commodities exported from the area—increased from year to year. In 1881 its population reached the all-time high of 5,585 and the town was looked upon as a coming metropolis.

[b] Villages on the Watershed:

As in the case of Port Hope, the small settlements on the river enjoyed a period of unprecedented prosperity from the 'forties to the 'eighties. Several communities had, by 1860, become established from the second to the eighth concession lines of Hope Township, and of these at least seven had sprung into being after 1840. They were Hastingsville, Welcome, Canton, Upper Canton, Perrytown, Adams's Corners, Choate's Mills, Dale, Davidson's Corners, Rossmount, Quay's Crossing and Knoxville. Also, between Osaca and Elizabethville, the village of Decker Hollow grew up near the township line, and Campbellcroft, which was originally known as Garden Hill Station, became an important shipping point.

Many of the villages had developed specific industries peculiar to them and thus received custom from other districts along the river. For example, Dale had the Basset Cider Mill and the Boyce Woollen Mill; Welcome was the site of the Brownscombe Pottery Works and of the Welcome Carriage Factory, and Perrytown had a soap and candle industry and carriage shops; Quay's and Knoxville had mills, while Davidson's Corners had a chair factory and Upper Canton manufactured chopping bowls from elm.

All along the river, the principal development occurred between 1860 and 1880, when most of the villages doubled their population. With the exception of Rossmount, which seems to have had little or no industry at any time, they were all thriving milling or factory centres. Garden



Courtesy of Canadian Geographical Journal.

POPULATION 1861–1941[1]

Year	Clarke	Hope	Port Hope
1861	6,575	5,883	4,162
1871	5,728	5,073	5,114
1881	5,069	4,522	5,585
1891	4,427	3,887	5,042
1901	3,788	3,273	4,188
1911	3,375	3,115	5,092
1921	3,039	2,754	4,456
1931	2,924	2,776	4,723
1941	2,814	2,494	5,055

Hill—which as Waterford had grown up in the 'forties—absorbed Adams's Corners, and this joint settlement became the most thriving village in Hope Township by 1870. It was the business centre on the middle stretches of the river, and alone supported five sawmills, two grist mills, and the largest woollen mill on the river, as well as a pump factory.

[1]Taken from Census of Canada, Volume I, in Census Reports, 1861 to 1931, and preliminary releases Census of Population, 1941.

By 1880, the population of Garden Hill was between four and five hundred, and its rate of growth had been so rapid in the twenty years previous to this that it was beginning to be looked upon as the market town for the middle and northern parts of the township. In general, this village growth may be said to have been caused by the thriving lumber business on the upper river and the lumbering operations in the northerly concessions of Hope and Clarke townships.

Prior to the 'forties, there had been no village settlement in Clarke Township on the watershed, but in the 'forties, Kendal sprang into being. Kendal, like Perrytown, Osaca, Canton, Elizabethville and Garden Hill—the other larger villages—derived its principal source of income from its milling business. In the 'forties, Theron Dickey had started a grist mill there and by the 'sixties, the village had two sawmills, two cooperages, four shingle makers, three carpenters and builders, a waggon shop, a lumber dealer, as well as a grist mill, three general stores, a drug store, a tailor's shop, an agricultural implement factory, a printer, three shoemaker's shops, a harness shop and two general blacksmith shops. By 1869, Kendal was a thriving post village, with two hotels, two churches and a school, and with a population of one hundred and fifty.

4. RETROGRESSION AND A CHANGING ECONOMY (1881-1942)

The era of decline—really under way in the township by the 'sixties—began to be felt in the 'eighties and was in full swing by 1900. The loss of the big timber trade on the lower river had occurred about 1880, while, on the upper reaches, it followed by the eighteen-nineties.

The old domestic economy had been dependent upon industries more or less indigenous to the soil, that is, upon general grains and timber, and manufactured articles deriving their raw materials from the forest, and upon industries producing articles for agriculture, or for domestic consumption. Generally speaking, the villages—and Port Hope as well—achieved their greatest prosperity under this economy. Two reasons for this prosperity seem to lie in the fact that they profited by the timber operations on the upper river and the increase in trade due to the putting through of the railway and the building of the harbour, both of which gave an impetus to trade with the United States. Although the big timber had been rapidly diminished in these years, it was the effect of the McKinley Tariff of November, 1890, which cut off the United States' general market and precipitated the economic depression. By this tariff duties were raised by an average of 50% on practically all commodities exported from Canada. These two factors, working in conjunction, killed industry after industry in Port Hope and village alike.

[a] Port Hope:

From 1881 to 1901 Port Hope lost steadily in population and in domestic industry and export trade. Its all-time high of 5,585 reached in 1881, had dropped in 1901 to 4,188 (its lowest figure since 1865). During the next decade, however, a slight recovery was observable, due to new industries being developed, such as the Nicholson File Factory, the Sanitary Works and other small industries.

The war of 1914-1918 did not bring any lasting stimulus to the town, and it was not until the 1930's that Port Hope again reached the five thousand mark, which is five hundred under its greatest census figure. With the establishment of radium refining by the Eldorado Gold Mines Limited in the 'thirties, and the war industry of the Second Great War era, the town is again forging ahead. Certain permanent industries, now settled there, presage that it may be able to hold its own after the war, in spite of the fact that its natural renewable resources have been exhausted or seriously impaired, and its flood hazard—which has grown in dimensions almost steadily since the 1870's—is not yet under control.

[b] The Villages on the Watershed:

The fate of the fifteen or more villages on the river followed, in the main, the same sequence as that of Port Hope, although it appears that the more northerly villages did not feel the impact of the depression as early as did the more southerly settlements. But, on the other hand, the villages have not attained partial recovery as has Port Hope, since the movement from the land in the agricultural communities of the watershed has been continuous.

To-day the rural communities on the river of any appreciable size or activity are Campbellcroft, Garden Hill, Elizabethville, Kendal Welcome and Canton. These settlements are now more in the nature of agricultural, than of milling centres. The only industry carried on in them is intermittent sawing, planing, and repair work, and the cutting of chop for the farmers, while the large saw, flour and woollen mills on the river are things of the past.

Many factors have contributed to the decline of these once thriving settlements on the river. Of these, a few may be mentioned:

First: The cutting of timber from the upper slopes of the watershed and its subsequent exhaustion, produced a slump in industry which could not be overcome;

Secondly: The opening up of land for agriculture at the north of the watershed was an error in land settlement since much of the soil is of low agricultural worth. When the natural "forest manure" was exhausted,

farming became increasingly difficult and led to the abandonment of the land;

Thirdly: The migration of young people from the farm to the city and the United States, and, in the last decades of the past century, to the newly opened Canadian West;

Fourthly: The loss of the pea trade through the depredations of the pea weevil, the decline in the use of horses for transport, and the effects of the McKinley tariff on export trade.

The general depression of 1929, from which the country as a whole had not completely recovered when the present war boom was ushered in in 1939, reacted on the Ganaraska; and other general causes for retrogression in rural communities had their effects within the watershed as well, although at this time there was a marked movement of population from the towns to the country. For example, mass production in industry itself killed small factories, while the automobile and the mail order house cut down the custom of the local store, thus depressing the economy as a whole.

Hence, it may be said that Port Hope and the villages lost to the large metropolis, and, through the exhaustion of the natural resources on the watershed, many of the early settlements have disappeared altogether, while those remaining are in general only skeletons of their former selves.

CHAPTER THREE

Land Division and Transportation

1. LAND DIVISION

THE British Government, when it took possession in 1763 of the former French Royal Province in North America, issued explicit instructions to the first Governor, James Murray, concerning administration of the territory. To quote in part from the order of December the seventh, 1763:

"You are therefore to lay out townships of convenient size and extent in such places as you, in your discretion, shall judge most proper; and it is our will and pleasure that each township do consist of about 20,000 acres, having as far as may be, natural boundaries extending up into the country and comprehending a necessary part of the river St. Lawrence where it can conveniently be had."

Prior to this, on 13 November, 1763, Sir William Johnson had written to the Lords of Trade that the Five Nation Indians (the Iroquois) "claimed possession of Ontario, including the Mississauga country." The first treaty giving the British rights to land, was made with the Indians by Sir William in 1764, and it concerned the territory bordering on the Niagara. In the interim between 1764 and 1784, however, the Ganaraska lands continued to belong to the Mississaugas, who had, it appears, established at least three villages on the watershed.

In 1784, Sir John Johnson, son of Sir William, made a treaty with the Indians which gave the British the title to land on the Ganaraska. By it, to quote from an alleged Indian document: "They agreed to let their Great Father have the lands according to his own proposals which they understand is from the purchase made by Captain Crawford to that made by their Great Father at Toronto. They likewise understand that the lands are not to run farther back from the shore of Lake Ontario than ten miles."[1]

This treaty, although made verbally in 1784, was not ratified until 1788, when "Shawingpaway with two other chiefs of the Rice Lake band in council assembled" formally made the transfer. At this time the Indians reported that: "they have taken the liberty of pointing out by two stakes which they have put on a small piece of land for their

[1]H. R. S. Ryan quotes this letter in a paper, stating that "it refers to the treaty, and appears to have been sent by the Indians."

great friends, the tradee at Pematask-watiang (i.e., Peter Smyth at Port Hope) who has always been very good to them."[1] This action constituted the first-known land survey on the Ganaraska watershed.

Over the territory thus passing to the white man from the red in 1788, Peter Smyth was the unofficial judge and arbiter between the Mississaugas and other Indian tribes on the north shore of Lake Ontario. In 1790, however, Smyth vacated his trading-post, turning it over to another trader, Herchimer by name; and, by this time also, Elias Smith of Montreal, and Captain Jonathan Walton had come as far west as the Ganaraska.

Subsequent to the passing of the Constitutional Act in 1791, John Graves Simcoe (the first lieutenant-governor of Upper Canada) proceeded to divide the four districts of Upper Canada into counties, for electoral purposes. Following this, the first survey of the front of these counties was made by Augustus Jones, who received his instructions on 14 February, 1791, and commenced the survey in August of the same year. On 16 January, 1792, nineteen counties were proclaimed by Governor Simcoe; of these, alphabetically Durham was the third, Northumberland the fourteenth. Following this, on 6 October, 1792, Elias Smith, Jonathan and Abraham Walton presented a petition to Simcoe asking for the creation of townships within Durham County. In response to this request, counties in the four districts were declared by proclamation of 15 October, the front of Durham being broken into the townships of Hope, Clarke and Darlington.[2]

After the convening, in 1792, of the first parliament of Upper Canada at Newark (Niagara-on-the-Lake)—to which session Durham (together with York and Lincoln) sent one of the sixteen members—special regulations were passed to assist the settlers and to attract pioneers. The legislative assembly offered special inducements to men of substance who would play a leading part in founding settlements in the unopened stretches of the country. The first inducement to hasten the opening of this area seems to have been made to Smith and Walton; they having been offered large tracts of land if they would settle forty families in the district.

To quote from a letter written by Elias Smith to Governor Simcoe: "Honored Sir: In the year 1792, Your Excellency was pleased to issue a proclamation for granting the waste lands of the Crown, in the province of Upper Canada in Townships in consequence of which proclamation

[1]H. R. S. Ryan quotes this letter in a paper, stating that "it refers to the treaty, and appears to have been sent by the Indians."

[2]Hope was named after Colonel Henry Hope, a member of the Legislature, Clarke after Major-General Alured Clarke, Lieutenant-Governor in 1792, and Darlington after Darlington in England. The back townships, Cavan, Manvers and Cartwright were laid out at a later date.

Jonathan Walton, Abraham Walton and myself were induced to present a petition for a grant of a township laying on the North side of Lake Ontario, known by the name of Hope, or Fifth Township. Our petition was laid before Your Excellency on the 6th day of October, 1792, which your Excellency was pleased to grant in Council. We then had reason to believe the lands which composed the township were to be our own, upon condition of our placing thereon forty settlers. We immediately engaged settlers."[1]

With the settlement of the white man on the Ganaraska, further surveying was done in the township and, in the summer of 1793, the land in and about Port Hope was laid out by surveyors, headed by Iredell, who had accompanied the original settlers from Newark on order of Governor Simcoe. During the following summer, more of the township was laid out and, by 1797, McDonnell had completed laying out the township. This survey followed approximately the lines of the ten concessions now existing.

Subsequent to the division of the townships, the representatives of the Crown were free to make, by Order-in-Council, specific grants of land to persons who fell within certain stipulated categories. There were, however, certain restrictions upon the freehold granting of land. For example, Clergy Reserves and Crown Reserves were retained for the benefit respectively of Church and Crown. Generally speaking, one seventh of all the land granted in the territory was retained by the Crown for the benefit of the Protestant Clergy. These reserves, however (as also were the Crown reserves), were leased to individuals on a twenty-one year basis and the rent accruing (or the profit from the land) went to Clergy or Crown as the case may have been.

Concerning the granting of the land itself, there were, generally speaking, six ways in which a settler might receive land in his own right:

First: As a United Empire Loyalist, or the son or daughter of a United Empire Loyalist—usually 200 acres;

Secondly: As a Military Claimant in acknowledgment of service in wars. Also, many of these grants were made upon the presentation of scrips—a type of deferred payment note from the Imperial Government. Military Claimants received lands according to rank, a general getting as much as 5,000 acres;

Thirdly: Grants to capitalists who, by reason of agreement with the Crown, bound themselves to make certain improvements on the land for the benefit of the settlers within a given time, or contracts for bringing

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[1]Letter written by Elias Smith from Montreal on 15th October, 1799, to Governor Simcoe, now in Harvard University Library.

settlers into the country and as recompense for establishing them on the land;

Fourthly: As a settler who agreed to clear land and to homestead the property. This regulation, called location, came in force in 1804 (Ontario Archives, Part IV), and reads: "Clear and fence five acres, to build a dwelling house within five years, and on proof of that and actual settlement, a deed was to issue for one hundred acres to him and his heirs, under the regulations of an Order of Council of the sixth of July, one thousand eight hundred and four;"

Fifthly: Outright purchase of the land;

Lastly: The old Common Law right of the squatter, recognized always by British law. Right of possession, when it was proven that the settler had been in residence for a certain length of time, was one of the ways in which much of the land was granted. In many cases, this privilege led to much duplication, since the Crown would grant land to some United Empire Loyalist, or Military Claimant, not knowing that another man had squatted on that parcel of land. In such cases, the squatter was usually given land elsewhere, or the new claimant transferred his right to some unclaimed land in the township.

The first grant recorded in the Ganaraska area was that made in June, 1797, by Order-in-Council, to Elias Smith, when he was awarded, as a Military Claimant, 3,000 acres of land in Concessions I, III, IV and V of Hope Township.

Between 1797 and 1912, Crown Patents were issued to settlers on the Ganaraska under the various categories, and land settlement followed, generally speaking, certain colonization waves. The sequence of land granting was, thus, to:

(1) United Empire Loyalists and Military Claimants after the American Revolution (1796 to 1812);

(2) Daughters and sons of United Empire Loyalists attaining their majority, Military Claimants and agriculturists from England and Ireland (1815 through 1820's);

(3) British, Irish and American artisans and tradesmen (1830's to 1850's). With the 'forties came the "Pine Land Grab" which constituted the taking up or transferring of the timber lands in the middle and northern reaches of the river. Land companies, also, had taken up lots in the area and placed settlers upon different tracts. Of these, the Canada Company and the local company headed by J. T. Williams were the principal speculators who took up land and settled families thereon.

By 1860, practically all the land in the drainage area of the Ganaraska had been granted and was under private ownership; while much of it had been, by this time, sold or transferred at least once or twice and some of it had changed ownership from eight to ten times. From the 'thirties to the 'fifties, much of the land held by the Crown as Clergy Reserves was sold, and most of the Crown Reserves were transferred to King's College and the Canada Company.

From consideration of Crown Grants and Crown Patents, it is seen that much of the land originally granted before 1820 was not "located upon", and part of it, at least, reverted to the Crown. Evidence of this fact is found particularly in Cavan Township. The reason for this state of affairs seems to have been caused principally by the state of the roads, or rather the lack of transportation facilities, in the interior of the townships. Since, thus, the building of roads played such an important part in the opening up of the watershed, it is necessary to trace briefly the sequence of road building during the early periods of settlement.

2. HIGHWAYS

[a] Indian Trails:

The old Indian "carrying-roads"—running from one inland waterway to another—date back to antiquity and, at the time of the coming to Hope Township of its first permanent white settlers in 1793, one of these trails is said to have cut the township not far back from the lake. This "Old Lake Shore Road" was supposed to have run about half way through the Broken Front of Concession I near the line of the present "Lake Shore Road." In the early days, it may have been the first communication line from Kingston to Toronto—or rather from Cataraqui (Frontenac's Fort) to Teieigon (Fort Rouille), a Seneca village near the mouth of the Humber.

There was also a carrying road between Lake Ontario and Rice Lake, by way of Dale and Sackville's Mills (east of Bewdley), giving access to the unexplored north country. It ran northeast from Dale to the boundary of Northumberland, and thence northward, but may not have extended to the mouth of the Ganaraska in early times, since the Indians travelled up the river by canoe as far as Dale. This trail probably followed the course of the Dale creek to the present Peterborough Road and then ran close to the road till near Rossmount, on the sixth concession line of Hope, then north-easterly through Northumberland to Sackville's Creek. This Indian trail was the original of the East Gravel or Peterborough Road and was used up to 1819.

The only other Indian trail in Hope Township at this time seems to have been the original of Walton Street. It passed through the centre

of the Mississauga village of Cochingomink, wound up a spur to the north-west and continued into the back country. This trail seems, after 1793, to have become a cowpath; and, prior to 1812, a log bridge had been built across the river on this street, which later became the main thoroughfare of Port Hope.

[b] Early Roads:

Certain of the early Indian trails became established as public roads in the first years of white settlement, although most of them were obliterated as the forest was cut, while road-building within the drainage area followed, generally, as a result of land surveys and of the granting of land to the early settlers.

Dundas Street: The first through road to be surveyed was the military highway from Montreal to London. This highway was named officially, Dundas Street, although locally parts of it are known as the York Road, Kingston Road and Danforth Road. It has always been the principal east to west road throughout the watershed. For most of its length, it was placed a little way back from the lake to avoid the marshes at the mouths of streams and also for reasons of military security. In the Ganaraska drainage area it followed approximately the line of the present King's Highway from Toronto to Montreal, and crossed the watershed at a point just west of Welcome and just east of Dale.

In the early years, roads were often not only impassable, but actually dangerous to life, as is evidenced by the following quotation describing conditions on the road east from York (Toronto) in 1827-28: "The horrible corduroy roads again made their appearance in a more formidable shape by the addition of deep inky holes, which almost swallowed up the fore wheels of the wagon and bathed its hinder axle-tree. The jogging and plunging to which we were exposed and the occasional bang when the vehicle reached the bottom of one of these abysses were so new and remarkable in the history of our travels that we tried to make a good joke of them."[1]

In the early days people travelled these roads on foot, on horseback, or in private carriages, but, with the advent of the stage coach about 1826, travel received a marked impetus. Also, the coming of the stage coach marked the establishment of the first regular mail service—it having previously been carried once a week from Trenton to Toronto on horseback. About 1830 some attempt was made to improve the more generally travelled roads and stage routes and, by 1831, the stage made five trips a week to serve the area. Although the roads in summer were quite good, in spring and autumn they were still practically impassable.

[1] "Travels in North America in the Years 1827-1828," by Captain Basil Hall, R.N., Engineer on the Rideau Canal.

In 1831, for example, a coach left Port Hope at 2 a.m. and did not reach Toronto until the following midnight. During these trips, travellers often had to walk a considerable distance and sometimes the coach would be marooned in mud, slush or snow and have to be dug out several times during the trip.

In the village of Port Hope itself, probably the first street to have been built was Mill Street from Peter to Walton with an extension on the "point"—the beginning of King Street. The original village itself, centring in the river valley between the eastern and western heights, developed first on the east side of the river. When the Indians left the western bank after 1793, however, white settlement spread to the site of the old Mississauga settlement of Cochingomink and the drier sites on the hillsides were chosen for permanent residences. The result of this spreading was that John and Cavan Streets were opened up not long after 1812 and later, in the marshy area, Queen Street was laid to the south, and Ontario to the north, of Walton.

East Gravel: Very early in the history of the settlement, need for roads to the back country was felt; and the provincial government was petitioned, in 1818, to build a road to Cavan Township.[1] An act was passed, and the road constructed forty feet in width. It was in operation soon afterwards, probably in 1819, and became known as the East Gravel, Cavan, or Peterborough, Road.

West Gravel: On 7 January, 1811, the inhabitants of Hope petitioned for a road to be built from Lot 8, Concession I, to Lot 12, Concession III (or rather from the Smith mills to Welcome). At this time in handling township matters a jury was called to debate the feasibility of matters of public interest and the record states "A Jury was empannelled on the utility of the above named road, who decided that the same be confirmed—Ordered, That the above road be confirmed and it be opened accordingly. (Signed) Asa Burnham, Foreman." This road was constructed, 183 chains long, and it ran "from front road between lots 8 and 9, 1st Concession, to Dundas Street." This connection with Dundas Street formed the first lap of what later became the West Gravel Road—the second northern highway in the drainage area.

Decker Hollow Road: Another early road to the back country departing from the survey was that which ran from lot 5, Concession I of Clarke to lot 33, Concession VI of Hope. It followed the boundary for a great part of its length and was built by joint agreement of the two townships. Its line was changed after a petition had been filed to change its line "in order to shun a very long and steep hill in lot No. 35 in the third concession of Hope aforesaid."

[1]Perth-Cavan Roads Act.

Later the road seems to have been extended on a curving line to Concession VIII, and this section was used by the early settlers of Elizabethville to reach Orono and Bowmanville, which places they used as market towns in preference to Port Hope—the latter being reached only by taking the rough trip eastward to Adams's Corners and southward on the West Gravel.

Middle Road: An important early road lying between the East and the West Gravel Roads was petitioned for in April of 1819 and put through from Choate's Mills to the northwest angle of lot 10, Concession II of Hope, where the Welcome schoolhouse is now situated. This road gave an alternative route from Canton and the surrounding area to Choate's Mills and Port Hope.

By the 'forties a much travelled road connected with this Middle Road was joined to it by part of what is now known as the Cranberry Road. In 1847 on a petition for "a proposed alteration of the public Highway", the road was carried up the line between lots 7 and 8 crossing the river at "Mr. Aldred's Mill" and continuing up three-quarters of the way across Concession V where it followed the line of the present road eastwards to Quay's Crossing. From Quay's, it led northward to Knoxville and on to Concession VII.

[c] Municipal and Toll Roads:

By 1850 the five highways generally serving the Ganaraska River system were: Dundas Street or the Danforth Highway, the Kendal Road or the Eighth Concession Line road, the East Gravel, the West Gravel, and the Middle or Cranberry Road.

The upkeep of these main roads became a heavy burden on the municipalities, consequently the practice grew up of letting out sections of them to individuals and to companies who would undertake to maintain them in return for tolls. This system was adopted in the case of the East Gravel before 1843 and probably about the same time in the case of the West Gravel.

The letting out of these important roads, however, led to the extensive use of the Middle Road so that the residents could avoid payment of tolls. The desire to avoid tolls, thus, had something to do with the tendency to open more of the side-lines. For example, in 1847, the following broadside in criticism of the Cobourg Road Company, formed to build the new connection into Port Hope, was published in the *Guide* of 15 March, 1859:

TENDERS will be received until the 20th inst. for the construction of 100 Mud Scows to run between Cobourg and Port Hope on the Macadamized (?) Road connecting the two places, which is owned by Cobourg Capitalists. The Company feel that the new mode of conveyance is necessary as the loss of horses, waggons and valuable lives in the fathomless abyss of mud during court week was fearfully alarming. Until the completion of the said Mud Scows the Company will continue to exact toll from those who may be so fortunate as to escape alive through the gates. Though the legality of such exaction may be open to question, they confidently expect that in view of the public spirit of the Company in providing the Scows aforesaid, the public will submit to be victimized. Dated at Cobourg this 15th day of March, 1859.

SIMON GRUMPY,
Sec. Road Co.

By 1881 the main roads within the Ganaraska watershed were satisfactory for waggons and horse-drawn vehicles, but with the coming of the motor car an entirely new set of problems arose. The majority of the secondary roads and many of the main roads failed to satisfy the demands of the motorist, but a steady improvement in the condition of the roads was noticeable after 1926.

3. RAILROADS

Port Hope, almost a metropolis in the pioneer period, was a pioneer itself in both the railway and the harbour field, since its merchants and manufacturers needed an outlet for their whiskey and timber products. Several abortive attempts to build railway lines in Durham County, in order to get a line running to Port Hope, were made in the eighteen-thirties and 'forties. For example, in 1832, before any railroads had been built in Canada whatsoever,[1] a railroad scheme had been initiated in which Port Hope took an interest. It was a proposed tram-line to Bewdley at the head of Rice Lake; and, on 9 January, 1833, Postmaster David Smart of Port Hope made application to the legislature for authority to construct such a line. Permission was granted but no action was taken. Again, in October, 1845, a public meeting of the citizens of Port Hope was held to consider the project of having the Toronto and Kingston Junction Railway pushed through to the port, but again no definite results were realized.

[a] Grand Trunk Railway:

The Grand Trunk Railway Company, which came into being in 1850, had as its ambition the building of a line from Halifax, Nova Scotia, through New Brunswick and the province of Canada (Quebec and Ontario) to the Great Lakes.

[1] The first railway to be built was a short portage road around Niagara Falls from Queenston to Chippawa. It was constructed in 1839, its company—the Erie and Ontario Railway—having been chartered in 1833.

By January, 1856, much of the Montreal to Toronto road was complete but there was a big gap between Brockville and Toronto. The road from Port Hope to the township line was completed on 1 September, 1856, and the line formally opened on 6 September. To quote from the *Guide* of that day: "A goodly number were at the depot grounds to see the Iron Horse harnessed for the first time in the history of the town to cars freighted with regular live Canadians." That day, also, saw the completion of the Spence-McKenzie section which ran through to Toronto; while a week later Fowler's section opened—thus connecting Grafton, Cobourg and Port Hope.

The Albert viaduct (built in 1856 and being 1,856 feet in length and resting on 56 piers) was named in honour of the Prince Consort. It was begun in May and, by the end of August, all the supports were in place. When completed on 13 October, this viaduct crossed the valley from the east to the west at Shuter Street. Apart from Victoria Bridge, Montreal, it was probably the most costly engineering project along the entire route. The following day the first train rumbled over it at (as stated in the *Port Hope Standard*): "A rapid rate about 40 feet above the locality where the 'dismal swamp' and the 'Canadian Nightingale' existed but a few months back. As soon as we cleared the curve on the west end of the viaduct steam was put on and the locomotive went over the rest at the rate of at least 45 miles per hour."

On Monday, 27 October, 1856, the first through train from Toronto to Montreal stopped at Port Hope for ten minutes. Before the year ended, four passenger trains were running every day, and, by 1901, twelve a day passed over this line. Owing to inroads made by the lake, the east to west road-bed had been moved by 1901 and the old Albert Viaduct replaced by a double-track structure between 1887 and 1893.

[b] Midland Railway:

With the completion of the east to west Grand Trunk line, south to north railway communications from Lake Ontario to Peterborough were sought. As early as 26 December, 1846, Port Hope desiring to build a line to Peterborough, had secured a charter. Subsequently the plans had been changed and the road built to Lindsay—the name for the line being the Port Hope, Lindsay and Beaverton Railway Company.

In September of 1856, the track-laying was at last commenced and, on 6 September, the rails were laid across Walton Street. On 5 November, the ten miles from Port Hope to Millbrook was covered and, early the next year, the road was pushed through to Lindsay. The line was officially opened on 31 May, 1858; and, by 1860, eighty-nine miles of rail had been laid. This railway cuts the watershed, from south to north, across the easterly part of Hope Township, near Dale, Quay's and

Perrytown and passes through Campbellcroft. There was regular train service along this entire route by 1876, and by 1878 Midland, on Georgian Bay, was the terminus.

[c] The Canadian Northern Railway:

The Canadian Northern Railway by 1910 had become a trans-continental main railway line across the country. Among its Ontario branches, the Montreal-Toronto line crossed the Ganaraska watershed. It was put through in 1911 and cut the southern area of the watershed from north-west to south-east, through Orono and Crooked Creek in Clarke Township and passed to the south of Osaca. From here it ran almost directly south-east to a point just above Choate's mills where it turned and followed the valley to Port Hope. This line was taken over by the Canadian National Railways and was abandoned in 1936.

[d] The Canadian Pacific Railway:

The Canadian Pacific line to Peterborough skirts the watershed at the north but does not cross it at this point. The lake shore line opened in 1914 crosses the watershed in the south and follows closely the line of the C.N.R., crossing the Ganaraska River at Port Hope over a viaduct a few yards upstream from the Albert Viaduct.

4. HARBOUR

A large marshy area lay at the mouth of the Ganaraska when the white man first arrived, and beyond it an island divided the river while, at the confluence of the two arms, the waters of the river poured out into the lake through a narrow gap or bottleneck.

All during the seventeen nineties and early eighteen hundreds, the sailing vessels had had to stand off from shore to unload their cargoes, which were ferried ashore. In order to expedite shipping, Port Hope had been constituted a port of entry in 1819, but no attempt seems to have been made to build harbour or wharf accommodations at this time — although the steamboat had made its appearance on Lake Ontario.

A decade after Port Hope had been declared a port of entry, the Port Hope Harbour and Wharf Company had been incorporated. By the terms of its charter, the company had been bound: "To construct a harbour which should be accessible to and fit, safe and commodious for the reception and shelter of the ordinary description of vessels navigating Lake Ontario and to complete the same by May 1st, 1844," under penalty of loss of its charter. Eventually, in 1832, a small pier had been constructed at which steamers could dock and a steamship

wharf and harbour constructed which ran out where the eastern pier now stands.

At the wharf, the harbour had a nine-foot six-inch depth of water. The schooners of those days, ranging from 110 to 130 feet in length, drew a four-foot six-inch draw when empty, but when loaded they displaced about nine feet, and it took much skill in navigation to manoeuvre in and out of the harbour.

Up to 1840 there was little organization and little permanency in lake navigation. Vessels were owned by private individuals as a rule, and from year to year were changed from one route to another but, that year, the Niagara Harbour and Dock Company inaugurated the Royal Mail Line of Steamers and thereafter there was daily service on the lake during the summer months.

After 1850, the Port Hope dock would take schooners of 137 feet in length, the pier having been extended out much farther into the lake. To form a protected harbour, another pier had been run out a corresponding distance on the west side of the creek's mouth but, in stormy weather and occasionally even in moderate weather, it was impossible for steamers to approach the land. Much loss was occasioned to merchants and travellers, and Commodore Hodder of the Royal Canadian Yacht Club described conditions graphically. To quote: "During a south or south-west gale this port cannot be made by large vessels drawing over nine feet of water, with safety, owing to the tremendous swell rolling in from the Lake; besides which the piers being only one hundred and twenty-five feet apart at the mouth and the basin very small, there is not room to check the speed of a vessel or to snub her without danger to herself or others."

In 1855 a new harbour was built and by 1867 it extended over five acres, projecting over 1,200 feet into the lake and 800 feet within the shoreline. A depth of 14 feet outside and 11 feet inside the shoreline was provided, as well as wharf accommodation of nearly 5,000 feet.

The Port Hope Harbour corporation had borrowed largely from the Municipal Loan fund—borrowed beyond its ability to pay, since most of the capital for construction was contributed locally. In 1867, it was taken over by the Federal Government and much money spent on maintenance and repairs. In 1878 it was one of the best, if not the best, harbour on the north shore of the lake, and local shipping through the port was of considerable magnitude up to 1900.

CHAPTER FOUR

Forest Products

IN dealing with the forest products of any part of eastern Canada, the usual historical sequence is to describe the taking out of ships' masts and squared timber, then the saw timber, and finally the smaller industries such as the production of fuel wood, ties, shingles, and posts. These different types of work, however, were carried on simultaneously in many cases and, in most areas, the first three types of work, at least, progressed at the same time; while in many instances, the smaller products were also being made. It would, nevertheless, be safe to assume that the masting and squared timber trades slackened off earlier than the other industries because these required the best and tallest trees of the forest.

1. EARLY POLICY

During the French Regime the timber resources of Canada were regarded as of comparatively little importance and "were treated merely as incidental to the general land policy." By the French system, the seignior had full rights over the land invested in him, although one restriction was imposed, namely, the French Crown exacted that he should "preserve and cause to be preserved by his tenants within the limits of the said tract of land, the oak timber fit for the building of vessels" for the French Royal Navy. The only aspect, thus, in which timber claimed attention from the French Government was in the "maintenance of an ample supply of timber for the Royal Navy," while "some later grants, in addition to oak, reserved timber for masts and spars, presumably pine."

During the British colonial period, the tables were turned, since the English laid the emphasis upon white pine, not oak, and they reserved only a small percentage of oak although they imposed strict regulations upon pine. The general policy of the home government, with respect to timber in the colony was twofold. First, it issued orders for procuring timber for the British Navy, and secondly, it passed regulations for the setting aside of forest reserves so that the supply of timber in the country might not be exhausted. To quote from the Annual Report of the Clerk of Forestry for the Province of Ontario, 1899: "When the British took possession of the colony in 1763 very elaborate instructions were furnished to the first Governor, James Murray, as to his administration of the new acquisition. The first thought of the Home Government in

relation to the forests of Canada was the necessity of preserving the timber for the same purposes which were regarded of such paramount importance to the French. They appear to have contemplated a more general and systematic method of accomplishing this object than the mere reservation of the timber in the deeds." This is corroborated by the fact that Governor Murray was expressly directed and required to reserve such parts of the country as abounded with woods producing trees fit for masting and other useful and necessary timber for naval construction and especially those in areas convenient for water carriage. "This land was," to quote the British order, "to be reserved to us and to use your utmost endeavour to prevent any waste being committed upon the said tracts by punishing in due course of law any persons who shall cut down or destroy any trees growing thereon, and you are to consider and advise with our council whether some regulation that shall prevent any sawmills whatever from being erected within your government without a license from you or the Commander-in-Chief of our said province for the time being, may not be a means of preventing all waste and destruction in such tracts of land as shall be reserved to us for the purposes aforesaid."

This policy of the British government, however, was not followed in Canada and extensive timber reserves were not maintained, as directed on pine-growing lands, although in 1775, 1789, and as late as 1818 the same policy was reiterated by the British authorities.

FARM FOR SALE.

BEING 65 acres, part of Lot 20, Concession 5, Hope together with a good Log House, and a frame stable.

This farm is well watered by Smith's creek, and consists of about 55 acres of good hardwood, and 10 acres cleared, the whole being good loam land. There is some splendid Cedar and Pine suitable for masts, and also some Rock Elm. It is situated about 6 miles from Port Hope.

The Farm is now for Sale by private contract on application to the undersigned, but will be sold by Public Auction in November next if not before disposed of.

SAMUEL MARTIN,
Hope, Aug. 12, 1876, 33-3m. Garden Hill P. O.

Port Hope Times, 1876.

Previous to 1826 the only persons authorized to cut timber on the public lands were the contractors for the Royal Navy, or those holding licenses from them, and there was great infringement on the regulation and much illicit trade, but in this year the first steps towards making the forest resources a source of revenue to the Province and "so securing to the public a share of the wealth drawn from the public domain," led to co-operation among the officials and the termination of the contractors' monopoly. "The inauguration of a system under which any one was at liberty to cut timber on the ungranted lands of the Ottawa lumber

One of the earliest products from the forest was the cutting of ships' masts for the Royal Navy, some of which were 120 feet in length—From an original drawing by Ed. Huxtable, as described by E. J. Bucknam.

region on payment of a fixed scale of rates to the Crown," overcame in large part the annoyance of the people and authorities in the colony against the export of the sound Canadian timber for the British Navy.

2. MASTING

The selection of mast timber was made by government agents who went through the forest blazing with a broad arrow—which was the mark of the British Government. As late as 1827, when Peter Robinson was appointed Surveyor-General of His Majesty's Woods and Forests in the province of Upper Canada, he was instructed "to make a Survey of the Woods and Forests within the said Province, and ascertain in what Districts there may be any considerable growth of Masting and other Timber fit for the use of His Majesty's Navy." Much later there was an area called "Mast Woods" on the Ganaraska, located between Canton and Osaca, from which such timber was taken.

The essential qualifications for good mast timber were: length, straightness, and a small butt in relation to the height of the tree. In cutting these, great care was taken to make sure that the timber would not be broken or injured in felling. Usually a bed was prepared by clearing away logs and small trees, and by levelling any irregularities on the ground with brush to break the force of the fall. In central Ontario these were cut both summer and winter. After felling, the bark was removed and the butt end of the tree was squared for eight or ten feet, ready for fitting into the mast block of the ship. For summer hauling, the front end of the mast was lifted by a winch under a pair of heavy wheels eight or nine feet in diameter, connected by a concave axle. At he rear end, it was supported under a pair of similar wheels, or sometimes smaller, with a straight axle. A sufficient number of teams, sometimes as many as twelve, was then used to haul the mast to the lake. In winter, heavy sleighs (sloops) were used and sometimes, with an exceptionally large timber, a long double-tree was fastened at right angles towards the rear end of the mast, with a team hauling on each side.

One of the old roads over which masts were hauled to Port Hope before the railway was put through, ran through Clarke Township near the eastern boundary to the lake. When it was more convenient to ship the masts by rail, it was not always customary to haul them to the station yard, but to a specially prepared railway cut. Into this the flat-cars were backed and the masts were rolled from the ground on skids which formed the sides of the cut. Although no records have come to light of the size of masts cut on the Ganaraska, judging from some of the pine now on the area and the verbal reports handed down from the settlers some of these must have been 120 feet in length.[1]

The mast and spar export to Britain was thriving in the '30's and '40's and it was continued intermittently as late as 1855, when a quantity was sold to the British Navy through the firm of Thompson and Cluckson of Port Hope. The British trade dropped off noticeably after 1854 and this may be attributed to the Reciprocity Treaty with the United States in that year, "securing the free exchange of the natural products between Canada and the United States, including 'timber and lumber of all kinds, round, hewed, and sawed, manufactured in whole or in part'," and the building of railway connections with the United States border cities.

3. SQUARED TIMBER

The squared timber trade commenced, no doubt, somewhat later than the mast trade and was carried on simultaneously with it from the

[1]The dimensions at the close of the Napoleonic period for the main mast of a first rate ship of 120 guns was 40 inches in diameter and 40 yards (120 feet) in length—Forests and Sea Power, R. G. Albion, p. 28.

The squared timber trade commenced somewhat later than the mast trade and was carried on simultaneously with it. As early as 1841 shipments of this material were made from Port Hope.

'30's, as is evidenced by a report appearing in the *Christian Guardian* of 28 July, 1841: "In 1841, 202 of the choicest masts and 100 immense sticks of squared timber were furnished by Messrs. Crawford and March of Port Hope. This year 800 masts and 800 sticks of squared oak and pine are furnished by these gentlemen."

Squared timber consisted of selecting large trees, mostly white pine, and squaring the best part into one long stick. In the earliest days of the industry the timbers were squared on all four sides to a fine "proud edge," but later when the best timber had been cut, they were squared with a rounded shoulder, or "wane", which was known as "waney timber". Such methods, of course, were wasteful since the finest grained wood was sacrificed in the operation, but this was the type of material called for by the British market.

In squaring timber a definite routine of procedure was followed. First, the "liner" would select the part of the felled tree to be included in the timber. He then indicated, generally by cutting a notch into the bark, "rossing", where the line of the square should fall. Next, with a chalk line he marked the line of the section (slab) to be taken off. Then the scorers mounted the trunk and notched the side at four foot intervals, almost to the depth of squaring, and with a special scoring axe knocked

the four foot chips off the side of the trunk. After this the scorers hacked parallel vertical rows about four inches apart along the full length of the timber. Then came the "hewers" with large broad axes who shaved it to a planed surface. The tree was then "turned down" and the other sides were squared in the same way.

The timbers were transported either by teams or railway to the lake, and were built into huge rafts, on which the lumberjacks built shanties and lived during the trip from the harbour down the St. Lawrence to the timber coves at Quebec. It is reported that annually crews of French-Canadians were brought to Port Hope for this work and lived in a group of shanties which stood in the neighbourhood of the present Town Hall.

During the years of the export trade of masts, spars and squared timber, a considerable domestic business was also being carried on in Port Hope, supplying ship-building requirements there. Repairs to schooners putting up in the harbour over winter, was one of the thriving businesses from the late '30's to the '80's and it is recorded that much of the timber from the last whole farm to be cleared in Hope Township was used for schooner masts.

4. SAW MATERIAL

From 1799 on, the cutting of timber on the Ganaraska had been one of the most important domestic businesses. Of course, it had first been used on the watershed in the form of round logs, for when the pioneers began to carve out homes in the wilderness of Hope Township there was not a sawmill within fifty miles.

In order to convert logs into boards the first method used was pit-sawing. This was sometimes done on the bank of the river, as such procedure saved the necessity of digging a pit. The east bank of the Ganaraska near its mouth, being steep and rather sharp, lent itself admirably to this purpose.

The more usual methods of pit-sawing on the river appear to have been the digging of a pit or building of a platform with a simple but firm and strongly constructed framework. In either case the framework was made the right height for one man to stand underneath, while the other man stood above on the platform or astride the log. This hand method of sawing timber was laborious, and twenty-five boards were a heavy day's work for two men; the boards being nearly always one inch thick, with planks two inches, and the occasional flooring of one and a half inches in thickness.

As soon as the pioneers were well established, they began to ask for a sawmill in their community. The power potentialities of the river being

U.S. Forest Service photo.

As time passed, methods of sawing lumber changed appreciably, but the up-and-down or muley saw was the type used on the Ganaraska from 1798 to about 1850.

there, a waterpower mill was demanded. Governor Simcoe, who was taking a personal interest in the settlement at the mouth of the Ganaraska, in 1794 requested Elias Smith and Jonathan Walton—the founders of the settlement—to construct saw and grist mills as speedily as possible for the pioneers. His Excellency, in turn, offered Smith and Walton a Crown Patent of Lots 5, 6 and 7 of the Broken Front and the First Concession of Hope Township "subject to the condition that the patentees should, with all reasonable diligence, erect a grist mill and a saw mill on the site." In addition, it was stipulated that they get all water privileges for a mile up the river and a chain of land on either side of the river for raceway and water rights.

On Oct. 8, 1797, an Order-in-Council was passed granting the land on which the embryonic town of Port Hope stood; and the joint mill was opened—as corroborated by a letter written by Elias Smith on 22 December, 1799: "The Grist Mill was grinding about 15 November and was doing well, the sawmill I believe was not going at that time." Accord-

ing to a record by the Honourable D. W. Smith, Surveyor-General, they were both in operation before the end of the year.

In order to estimate the magnitude of timber operations within the drainage area of the Ganaraska, it is necessary to follow briefly through the years from 1795 to 1942 and to see what sawmills were operating by waterpower on the river and its tributaries during this time.

In the pioneer period—roughly from 1793 to 1837—at least seven mills came into operation. Of these, three were in Port Hope itself, two others on the main river within two and a half miles of the town, and two on tributaries. The tributary streams first supplying waterpower were the Duck Pond Branch—the first appreciable brook coming into the main river—and the North Ganaraska Branch—the largest tributary of the Ganaraska and the branch upon which the larger percentage of milling activity has taken place during the whole period since colonization began.

As time passed and other mills came into being, methods of sawing changed appreciably but the up-and-down or muley saw was the type used on the Ganaraska, from 1798 to about 1850. This saw was a power-driven adaptation of the pit saw. It was mounted in a frame of heavy timbers, in which the saw was held taut in a vertical position. The frame slid up and down in two upright grooves and was worked by an arm fastened to an eccentric. The log was placed horizontally on a carriage made of heavy timbers, and fed into the moving saw by means of a rope or cable hauled by an axle which was turned by hand.

The second or industrial period on the Ganaraska—continuing from about 1837 to 1880—saw great development in the sawmilling industry. Up to 1850, perhaps, the most phenomenal growth occurred. Between the Rebellion of '37 and 1850, eighteen new mills had come into being. Of these, six were constructed on the main river, while one was built on the Duck Pond Branch, two on Quay's Branch, seven on the North Ganaraska Branch and its tributaries, one on the Little Ganaraska, and one on the Soper Branch in Clarke Township. In 1850, also, the seven early period sawmills were running, although in some cases under different owners.

The events leading up to, and the building of the Wilson mill, as recorded in the Wilson diary[1] give a picture of conditions in this period.

"April 1843 John Haigh whent to New York to get 2 men from Manchester Mathew Smith & Son Thomas millwrights they could get no work in the States at that time. they had Worked in Same Shop with him in England. Charles Callander hewed the timber. Robert

[1]Now in the possession of Edwin Wilson, Garden Hill, Ontario.

Corbett & John D. Caldwell Scorers John Haigh my Brother James & me & the Oxon drew it out in 2 days to the South West corner on the flat next the Gardiner land. 6 sticks 50 feet long. 1 foot square & near 40 Sticks 20 feet in 2 days some 14 x 4 all 12 x 12 long got the mill raised in June. it took A good many men all day to raise it. All green timber. My Mother and Mrs. Bennet Cooked the meals for all of them without aney other help on the Old fireplace. John Haigh got money from is folks in the Old Country it took A great deal of money & time to build the dam it was so wide from Bank to bank, so to be seen to this day (1910) My Father to give John the Water privilege for so long my Father to get all the lumber sawed for our buildings free time, so my Father put the pen in his hand to take his own time he set down 15 years we did not know for some years what the bargain was between them it was very good for us."

By the 'forties, the muley saw was gradually replaced by the circular saw. Also, the old method of felling trees by the axe was superseded by sawing, and the old cross-cut saw with uniform teeth was replaced by the drag-tooth or modern cross-cut saw.[1]

From observations of old barn frames and of the oldest boards in existence known to have been cut on the watershed, some idea of the size of the trees can be obtained. For example, planks cut after 1844 at the John Wilson sawmill, Hope Township, Concession 5, Lot 19, which used the up-and-down saw are reported to have been from trees 4½ feet in diameter and from 80 to 100 feet long, while trees up to 5 feet in diameter and over 100 feet long were cut. These trees are said to have been so large that V's had to be chopped into them before the saw could be inserted to saw them.

Through the 'fifties and into the 'sixties, the lumbering trade on the river continued to increase, and between 1850 and 1861, there came into operation thirteen new sawmills.[2] Of these, six were built on the main river—four of them located in or to the north of the village of Kendal in Clarke Township where great activity occurred in these years. Of the new mills erected on tributaries, one was added on Quay's Branch, four on the North Ganaraska and its tributaries, one on the Soper Branch, and one on the Burnham Branch.

From 1837 to 1861, thirty-one new sawmills had been built on this small river system. While all the early period mills were running, in most cases they were being carried on under different proprietors and in some instances had almost or completely stopped cutting. For

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[1]The cross-cut saw was not used on the Ottawa until 1875—*A Hundred Years A'Fellin'*—Gillies.

[2]See map accompanying this report.

example, the early Smith mill in Port Hope (the Viaduct Mills) had become principally grist by 1852 and had definitely stopped cutting timber in the 'sixties; the Boyce mill near Dale had, by the 'thirties, become a carding and fulling mill and it is believed did not do much cutting, if any, in the 'sixties although it did revert to sawing after 1878; and the Salter mill (Durham Mills) had, by 1850, become almost exclusively a grist mill and had ceased cutting by 1861.

From 1861 to 1866 it is believed that thirty-five of the thirty-eight sawmills built by this time were still operating on the river and its tributaries, but at this time a gradual decline in the sawing industry is apparent. Between 1867 and 1880, seventeen mills had either stopped sawing or had disappeared altogether from the river and its tributaries, and of these eleven were on the main river, one on the Duck Pond Branch, two on Quay's Branch, two on the North Ganaraska, and one on Burnham Branch. These mills were scattered generally throughout the watershed, except around Garden Hill and Kendal, for the milling activity on the North Ganaraska and in and about Kendal village showed no decline in these years. Some of the mills which went out of business were burned, several had their dams carried away by flood waters, and several failed.

Running on into the 1880's were eighteen mills, and of these seven were closed by or about 1885, of which only one was on the main river, two on the Little Ganaraska and four on the North Ganaraska. By this time, the loss of business began to be marked in and about Garden Hill and Elizabethville, and it was these villages which may be said to have suffered most disastrously from the depression and the exodus of young people from the farms around the villages. After 1880, however, one new sawmill seems to have been built—that on Knox's Creek, a tributary of Quay's Branch—but its life was short. The total, then of sawmills about 1885, was twelve.

Between 1885 and 1912 five more mills closed or stopped sawing and of these, one was on the main river, one on the Duck Pond Branch, one on a tributary of Quay's Branch, and two on the North Ganaraska Branch. About 1912 the Comstock sawmill in Kendal was closed, but the old Watertown grist mill in the same village was opened as a sawmill by its new proprietor, leaving the total of sawmills running on the river at seven.

From 1912 to the present, much of the sawing on the river has been done by the portable or the steam mill, and to-day of the seven mill properties in operation, only two are reported to do actual sawing, while the others are chop mills, planing and woodworking shops, or—as in the case of the Durham Mills—grist mills.

5. SHINGLE MAKING

In the history of roofing used on the Ganaraska Watershed, it is found that the first covering for human habitations on the river was the Indian elm bark lashed roof, while the first wooden covering used by the white man was a rude type of shingle called a "shake". These were made with an axe, or frow,[1] and were cut from pine or cedar, three or more feet in length. Although unshaped, they were a great improvement over bark covering.

Very early in the history of settlement on the Ganaraska, however, hand-made shingles were introduced. The shingle-maker would saw the log into short lengths or bolts, and split them by the use of a frow to the right thickness. The shingle was then fastened by one end in a device called a shingle horse and by means of a heavy draw-knife, the shingle was tapered to an edge. This method was rapid and it has been said that a good shingle-maker would turn out from eighty to a hundred of these hand-made shingles in an hour.

Up to the 'seventies and even later the shingle-maker continued to use draw-knife and frow; but gradually in the 'seventies the generation of craftsmen died out and the shingle mill became the general source of supply. In 1869 Kendal alone had four shingle-makers plying their trade, while in 1880 not a single shingle-maker was listed on the entire watershed.

6. STAVES AND COOPERAGE

Although the earliest record of a cooperage mill on the river is about 1830, long before this time hand-made oak kegs had been built to contain liquids. Since Port Hope exported whiskey to Britain as early as 1810, it is presumed that coopers were making the kegs from white oak by this time. Probably the early carpenter turned his hand to this work, or perhaps Smith brought in coopers to build the kegs. Although white oak was the original stave wood, by the 'thirties the use of elm for potato, apple and flour barrels was common and hickory and also ash were often used for barrel hoops.

Barrels and kegs which were made from 1800 in Port Hope yielded a considerable output by the 'thirties and by 1847 or '48 Harvey Soper was running a stave mill in conjunction with his sawmill, while by 1860 Thomas Molson was carrying on a very large cooperage business at his big flouring mills above Port Hope. There were thirteen cooperage shops on the river by the eighteen sixties and 'seventies, one at Dale,

[1]The frow is an adaptation of the steel wedge. It is about eight inches long, with a wooden handle at right angles at one end. The shingle-maker held the frow over the end of the wood to be split, and pounded it with a mallet.

two at Welcome, two in Canton, one in Perrytown, one in Garden Hill, two in Elizabethville, one in Decker Hollow, and three in Kendal. To-day, barrels are imported into the area—there being not one stave mill in operation on the river.

As well as the domestic trade in shingles and staves on the Ganaraska, an export trade in shingle and stave bolts was carried on with the United States. It is presumed that, during the years of reciprocal trade (1854-1865) this business had increased greatly and, after 17 March, 1866, when the treaty expired a new tariff was put on Canadian products. To quote: "export duties were imposed on saw logs and shingle bolts shipped from Canada, excepting to any of the British North American Provinces, at the rate of $1.00 on every thousand feet, board measure, for pine, and 50 cents for every thousand feet, board measure, for spruce."

Under Confederation and during the 1868 session, additional export duties were imposed.

Shingle bolts, per cord of 128 cubic feet	$1.00
Stave bolts, per cord of 128 cubic feet	1.00
Oak logs per M	2.00
Spruce logs per M	1.00
Pine logs per M	1.00

Of the exports shipped from Port Hope harbour in 1850 to the United States—apart from those going to Montreal and other British ports—lumber amounted to $38,000; wheat $15,000; flour $16,000; over and above produce and stock. While in 1865, the exports of Port Hope and Peterborough combined had jumped to a total of $833,862, with over half of this figure being realized from products of the forest alone—namely $456,434. On the other hand, shipments through the harbour of Port Hope for the season of 1879 were:

Lumber	50,000,000 ft.
Barley	475,477 bus.
Wheat	296,522 bus.
Peas	38,288 bus.
Rye	17,779 bus.
Shingles and laths	13,311,000

Stock and miscellaneous produce.

7. FUEL AND TIES

From the earliest days of settlement on the Ganaraska to 1850, wood was the sole source of fuel supply. The species used for this purpose in the vicinity were beech and maple—although these were the furniture

Shipments of lumber from Port Hope Harbour in 1879 amounted to fifty million feet—From a wood-cut in "Picturesque Canada," published in 1882.

woods as well. And, with the inception of steamship travel and later the railway, and steam-driven factories, the forests of the area were ruthlessly cut to feed industry.

In the very early days of the steamship, 1832, the Honourable Adam Fergusson writes: "Wood is furnished upon the St. Lawrence for one dollar, or five shillings per cord, while upon the Hudson it now costs three times as much. . . . A man may prepare two cords a day, but it is severe work, and the price, which is one dollar per cord, will do little more than compensate maintenance and labour . . . and an ordinary steamboat consumes fifty or sixty cords, or about 7,000 cubic feet each trip (from Montreal to Quebec)." The price of cordwood in 1825, in the Ganaraska area, was quoted at $2 a cord, while in 1942 it sold at a ceiling price of $12.

With the completion of the Grand Trunk between Toronto and Montreal in 1856, locomotive requirements took large quantities of the best body hardwood, chiefly beech and maple, from the Port Hope and Newcastle regions. As late as 1871, Newcastle was still an important cordwood market for, on 16 January, the municipal council of the village granted to Richard and William Grose a commutation rate of

$50 per annum for 2,000 cords of wood passing through the village toll-gate (over 2½ cents per load).

The nest of saw and allied mills opening up around Garden Hill, Elizabethville and Kendal in the 'forties and continuing generally up to the 'eighties and 'nineties, was brought into being or at least stimulated by the putting through of the railroad, and with this a new wood use came into being, namely the cutting of ties. Thereafter ties, as well as cordwood, were cut on the watershed.

8. ROAD MATERIALS AND FENCING

In the early days, the making of corduroy roads furnished another important wood use. The Indian trails had followed the ridges and natural conformation of the country, but when the "T-square" roads had been laid out in government offices, they followed the arbitrary lot and concession lines regardless of natural contours. Many of these roads were built through swamps and in these places corduroy construction was used. Many corduroy bridges and culverts were also placed over the river and its tributary streams.

The building of plank roads—a form of highway in which the planks were laid crosswise and side by side—was done in several parts of the province. Several of these were found on the Ganaraska, particularly on the way to Cavan Township. The date of these roads is obscure, but it is recorded that a plank road had been built from Whitby Harbour to Lake Scugog as early as 1846. Dimensions of the timber used in a standard plank road are given in the Report on the Grand River Drainage, 1932,[1] where it states that: "The Hamilton to London plank road was constructed of three-inch by sixteen-foot pine plank of first quality. The planks were laid on three by six-inch pine runners which were two and one-half feet apart and ran parallel to the line of traffic. The surface planks were spiked down to the runners by hand-made spikes, some of which are still to be found when reconstruction work is undertaken."

The *Christian Guardian* of 3 July, 1844, states that four miles of plank road could be made and maintained at the cost of one mile of macadamized road. After 1860, the era of the building of corduroy and plank roads was nearing its end although plank roads already in existence, such as the one in Cavan Township from Hope, were in use up to the 'seventies at least.

Much wood was also used for fencing and for this cedar from the swamps was most common. The troublesome pine stump, also was used for this purpose, although in the very early times it seems that it was left

[1]Report on Grand River Drainage, 1932—Appendix, page 98, Roger M. Lee.

in the fields. Many of these old fences are still in use on the area to-day. Around 1900 the wire fence came into use generally and thereafter a fence-post industry was developed: these were cut as a rule to a standard length of eight feet, while the diameter varied greatly.

9. WOODWORKING AND PLANING MILLS

During the early years of settlement in the rural districts and communities on the Ganaraska, house trim for exterior and interior was made by the same man who constructed the frame of the house. The custom up to the 'fifties at least, was for the carpenter to board with the family the winter before the new frame house was to be built and work all his timber into shape by hand, ready to go into place as soon as the house was raised. These early carpenters did all the planing of boards by hand, both for exterior and interior use.

For the exterior of the frame house, very early in the history of building on the Ganaraska, the clapboard or weatherboard came into use. The clapboard—primarily a North American product—had come into use in the United States as early as 1671. Wide and heavy, it was made by hand of pine or cedar and probably its earliest use on the watershed was for facing or making "frame fronts" for log houses.

The early carpenter also made door and window frames and all interior trim of the house by hand, and, for all these products, pine was the usual type of timber chosen. It would seem that doorsteps were one one of the very few things for which oak was used in house building, at least up to the 'sixties. For example, an old-timer on the watershed is reported to have said, when asked if they used much oak in the early days, "No, we didn't need to. We had plenty of pine."

The first carpenter to come to the Ganaraska was Joseph Caldwell, who settled in Port Hope in 1800. He was followed in 1801 by James Hawkins, blacksmith, who also did general building. By 1820 John Wallace, contractor and builder, had established himself in the community.

Each of the villages had from early days a general carpenter, although in the very beginning the building was done by the settlers themselves, usually at building-bees. This is corroborated by the diary of Edmund Wilson, who gives a description of clearing and building operations on the middle reaches of the river during the early eighteen forties. To quote: "That week Robert Corbett Isiah Hillis and others cut down 5 Acres. he then began to prepar for Building A house after cutting the logs in proper lengthes on the 3rd of July our Neighbours to the Number of 20 or 30 came forward and asisted in raising them up this is wat

Neighbours do for every new comer. Our House is 28 feet long and 20 feet wide & 10 logs high each log about 12 inch in diameter, the round side of each log is hewed of in the incide and the criveces are filled with plaster which makes it pretty smooth. Our chimny is Brick—our Flore is Boards. 7 inch in breadth and 1½ inches thick we have 3 Windows of 12 square of Glass 10 inches by 8 and 1 Window in the upper Room. The roof is a very good one & covered with Shingles that is split pine in imitation of Slate. The Cellar is 12 feet by 10 with board flore. We have a beautiful Spring of Water at the Back of the House."[1]

Generally, as time passed, the building trades became more differentiated, and more craftsmen settled on the watershed, while by the 'sixties and 'seventies, Dale had two carpenters, Welcome four, Canton three, Perrytown one, Elizabethville four, and Kendal five.

After the appearance of the planing mill in the 'fifties, the end of the hand-made door and window frames was foreshadowed and much of the general carpenter's work was taken over by mill or factory. For example, in the eighteen sixties, the planing mill business was well underway at least in Port Hope, there being at that time three planing, sash, door and blind factories in the town.

10. WOODEN IMPLEMENTS AND VEHICLES

[a] Early Tools:

Once the temporary log-cabins of the original settlers in Port Hope had been completed in the summer of 1793, they had set to work to augment their furniture and household utensils by roughly hewn articles. The split log bench with four peg legs was probably the first seat made by the pioneers who—although they had been able to transport little furniture and fewer household utensils—seem to have had no farm implements at all with which to work except the American axe, the cross-cut saw, the bucksaw, hammers, spades and scythes. The big trees of the forest were burned after their requirements for fuel had been supplied, and, as soon as the snow and ice had melted, the land was made ready for planting.

From the very early days, hickory was preferred for the making of axe-helves or handles, while for beams or ox-yokes beech was used extensively and, for the loops, ironwood would probably have been selected. Spike handles were made of rock elm, white ash, hickory or ironwood; the beetle-head (a mallet used for pounding hemp and flax) was also made of ash, elm, hickory or ironwood. The hardwoods growing

[1]Extract from diary of John Wilson, quoted by his son and carrying date of April 27, 1841.

on the watershed were used almost entirely for making handles of implements, whereas pine was preferred for all building operations.

As settlement developed and more craftsmen arrived in the area, the general types of agricultural implements improved and metal replaced wood in large part. The use of wood for specialized products, however, continued until the eighteen nineties at least, as evidenced by the chopping bowl industry which used the whole of the elm supply from the famous Beaver Meadows just north of Canton, where a little village within a village had grown up about 1880.

[b] Vehicles:

From the first rude cart made by hand in 1793 and 1794 by Myndert Harris to the elaborate factory-made carriages of the '70's and '80's is a wide leap. Nevertheless, this rude cart built the first winter after the pioneers settled at Port Hope was, to quote the story later given by Myndert Harris the younger, "an improved kind of vehicle for those days." It had solid wooden wheels, without spokes or iron binding: the wheels probably being made of two split pieces of hardwood cleated together. By the following winter, his son records that Harris "made another pair of wheels which rejoiced in tires made of iron procured from Montreal, and the result was the first wagon ever seen in Port Hope."[1]

After this time the making of vehicles progressed, as carts, waggons, sleighs, and hay and wood racks were built by the farmers. In the building of carts and waggons, whiffle-trees, waggon-tongues, and binding poles were made of rock elm, white ash, hickory and iron-wood, as were also sleigh-runners and hay and wood racks. Usually the wheels or runners of these conveyances were bound with iron, or with tin, although the use of metal was limited in early days, since the supply had to be imported by water and either ferried ashore or, after 1800, brought in from the schooners across the Smith hemp walk.

The Robert Chalk Carriage Factory—opened in Port Hope in 1842—carried on an extensive business. By the 1850's even the covered buggy was being produced. The extent of this industry on the watershed is seen by the number of carriage factories and waggon shops in operation in the 'sixties and 'seventies. For example, apart from Port Hope's thriving factories, Welcome had five carriage makers, Perrytown three waggon shops and two carriage makers; Elizabethville, Garden Hil and Adams's Corners a carriage shop each and Kendal a waggon maker.

11. INDIRECT PRODUCTS AND BY-PRODUCTS

In addition to direct wood uses—such as the building of habitations and other structures, the making of wooden implements, furniture,

[1] *Port Hope Guide*, 1870.

barrels, kegs and other containers, and vehicles—indirect and by-products were manufactured on the Ganaraska from the earliest days. Some of these products were exported, but in general they were used for domestic consumption: the three of greatest importance having been maple sugar, lye and tanbark. Maple sugar furnished the staple sugar for the pioneers—cane sugar not, at that time, having been procurable; lye, or potash, was used domestically in making soft soap—almost the universal soap; tanbark was utilized in dressing leather by the shoemakers.

[a] Maple Sugar:

The boiling down of sugar from the sap of the hard maple is of primitive origin, the Indians having made it from very early times and the pioneers, in general, used their method, although the birch bark bucket soon was replaced by the big iron kettle. In size this ranged up to nearly four feet in diameter; and the fires were kept burning under the kettles night and day in the woods during sugaring-time. The early settlers made sugar exclusively and then, if they desired maple syrup, they would turn it back into syrup. In the diary of Edmund Wilson is the following excerpt referring to sugaring operations: ". . . In winter of 1841 and 1842 their was very little snow. The sugar making commenced very early in March the finest Year for it I ever saw, we made near 200 lbs."

[b] Potash:

The ashery played an important role in the drama of pioneering life; and a communal ashery had been established in Port Hope by 1812. Prior to this and long afterwards throughout the watershed, the individual ash house and the ash barrel on a platform for leaching was a characteristic of each farm in the days before the soap manufactory came into being.

In the production of potash for export, the early settler gathered the ash from hardwood burnings in the forest. The ashes, gathered with as little dirt as possible from the log heap, were put into a barrel or leaching-tub of domestic manufacture. The mixture would then be boiled until it grew hard. The lumps of potash salts thus obtained were packed in two hemispherical kettles placed together in a barrel for shipment.

There were two grades of potash, the ordinary rough type sometimes called black ash or potash, and the more refined product which—after a second boiling—was called white or pearl ash. The former was used domestically, but the country merchants would buy the pearl ash for exportation to Britain where it was used particularly for the bleaching of linen and cotton.

The boiling of sugar from the sap of the Hard Maple is of primitive origin, the Indians having made it from very early times. The pioneers in general used their method, although the birch bark bucket soon was replaced by the big iron kettle.

In the correspondence of Elias Smith, dated 28 October, 1800, the following citation occurs: "I foresaw the fall of pot and perl ashes. I did not take the tentum of potashes I had the promise of." By the 'forties, potash was sold for as much as $2 a keg and was used extensively by the early soap manufacturer on the river. In this period, too, there was an old potash works on the top of a hill in the Garden Hill area, where the road curves round Dean's Hill to Elizabethville. By the time the big soap manufactory was developed in this part of the country, the individual and communal asheries had become things of the past and no reference has been found regarding these after eighteen-eighty.

[c] Tanbark:

From the earliest days of settlement on the Ganaraska, the local tanner played quite as important a role as the sawyer, miller, blacksmith, or store-keeper. As time passed, the tannery came into prominence as leather-goods came into greater demand. In the process of curing hides, an extract from the bark of the hemlock was used and, hence, this indirect use of timber—not at that time considered to be of much economic value in other fields—grew into a local industry of considerable size.

Apart from this local trade, the export of hemlock bark from Ontario to the United States had grown to such size by the 'sixties that alarm was felt by the governmental authorities at the waste of timber arising from this indirect use. A special committee appointed to consider this question made an investigation by which the following facts were brought to light: "The quantity of bark exported annually from Canada to the United States was estimated at not less than 100,000 cords, which at ten cords to an acre, represented 10,000 acres annually stripped for the supply of American tanneries. This process resulted in the wholesale destruction of timber, the trees being generally left to rot on the ground, largely increasing the danger of forest fires."

Certain distinctions were drawn by the committee between local and export trade in the selling of this raw material. To quote: "The Committee concluded that the bark consumed in local tanneries was applied to a legitimate use, benefitting both the settler and the country at large; the settler was enabled to bear the cost of clearing the land by the sale of the bark and at the same time had opportunity to dispose of the timber to advantage, as the work of clearing gradually proceeded."

No government action was taken on this matter at the time, and the devastation of hemlock forests generally continued throughout the country. The McKinley Tariff of 1890, however, put an end to this unpropitious trade just as it did with the more profitable general lumber trade. In the Ganaraska, local tanneries continued to manufacture leather up to the 'nineties and the extraction of tanbark for local use was carried on until most of the large leather manufacturers removed to larger centres.

CHAPTER FIVE

Water

1. SUMMER FLOW

[a] The Natural Circulation of Waters:

"THE total quantity of water in, on and about the earth is believed to be fairly constant, but it exists in various forms and places; as liquid or ice in the oceans, lakes, rivers and other surface waters; as liquid or frost in ground and underground storage; as clouds, fogs, mists, and vapors in suspension in the atmosphere."[1]

The water of the earth is therefore in constant motion as it changes from one form to another, and from place to place. This constant movement and circulation of water is called the hydrologic cycle.

In tracing this cycle, it is customary to commence with the evaporation of water from the earth's surface. This includes not only the evaporation from large bodies of water such as oceans, lakes and rivers, but also evaporation from falling rain, the soil, and transpiration from plants. The moisture-laden air is cooled as it rises upwards, or as it comes in contact with cooler bodies of air, and the moisture is dropped in the form of rain, snow, dew or fog, which is known as precipitation. Of the precipitation which falls upon the earth, some is absorbed by the atmosphere; a large amount is carried away by streams and rivers and forms the surface run-off; while some is caught in ponds and swamps which form natural reservoirs. Some precipitation sinks into the soil and is used by vegetation, while a greater quantity, where conditions are suitable, sinks deeper into the ground and forms an underground reservoir known as groundwater.

"That part of the rain and snow fall that is absorbed by the ground is of very great importance," states Professor R. F. Leggett,[2] "even though it is seldom given much consideration in general discussions of water resources. It sinks down until it joins the vast underground reservoir of water, the water called groundwater, that exists under practically all parts of the earth's surface, except where that surface is solid rock. It is this groundwater that feeds springs and provides the water drawn from wells; much more important however, is its function of providing that relatively steady discharge that makes up the flow of

[1]H. S. Person in "Little Waters", U.S. Soil Conservation Service.

[2]Reconstruction in Canada—University of Toronto Press, Toronto, Ontario.

rivers at all times when rain is not actually running off the catchment area. For rivers do flow in general at all times, rain or no rain, summer and winter, due only to the hidden supply provided by groundwater."

Thus, in these various ways, the water of the earth finds its way back again to the lakes and oceans and completes the hydrologic cycle.

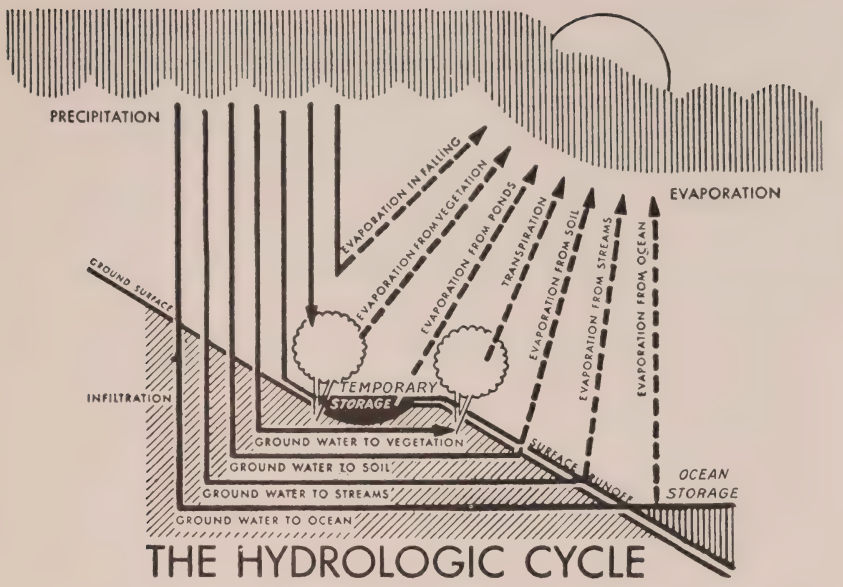
[b] The Relation of the Moraine on Summer Flow:

The dominant feature in relation to water supply and summer flow on the upper part of the Ganaraska Watershed, is the water-holding capacity of the morainic upland, with its numerous kettles, or pot-holes, composed of porous sand and gravel deposits into which the water sinks. Coupled with the water-holding capacity of the morainic upland, is the high elevation of the area, which at the Pontypool ponds has an elevation of 1,050 feet, and the less porous layer under the gravel overburden, which has a direct effect upon the underground flow.

How far south on the watershed the effect of this deep seepage is felt has yet to be proven. It is safe to say, however, that most of the wells of moderate depth on the upper part of the watershed, that is, above the Kendal-Campbellcroft road, are supplied by water from this source. Certainly the numerous headwaters which commence at the base of the back slope of the moraine receive their supply from here. This is evidenced by the never-failing supply of water which rises from beneath the drifting sandhills at certain points along the face of the moraine. Furthermore, it appears that, when the upper part of the watershed was heavily timbered, springs were more numerous, and the streams commenced farther up the slope than they now do. It is safe to assume, therefore, that, with the replanting of these areas, the summer flow in streams would be increased and there would be more deep seepage through the morainic gravels for water supply to the wells on the area.

[c] Farm Use of Water:

In enumerating the sources of water supply for domestic and farm purposes, on an area as well-watered as the Ganaraska, it is natural to expect that many farms use the river for this purpose. For domestic use, however, and, in the majority of cases for stock purposes, wells of different types are used. Wells are usually classified as (1) dug wells, with curbing of wood, stone, concrete or metal, and (2) drilled wells, which are usually much deeper and sometimes drilled through solid rock, to reach an abundant supply of water. The bottoms of dug wells usually reach below the top of the water table, or in some cases are fed from springs near the surface, while one class of drilled well, known as a sand point, is driven by hand and is of moderate depth. Artesian wells are



Courtesy of U.S. Soil Conservation Service.

usually drilled by power, although some are put down by hand. Their chief characteristic is that the water rises under pressure up into the pipe and in many cases comes to the surface and runs continually. This type of artesian well is known locally as a "flow".

Most of the wells on the area are of the dug type, although several have been drilled and there are some good examples of artesian wells, particularly in the vicinity of Campbellcroft. During the survey, a census of water supply for farm stock and domestic use was made. It included an examination of the water supply on 221 farms in Hope Township, and 68 in Clarke Township.

Of the 221 farms in Hope Township, 168 reported dug wells, 27 reported drilled wells, while 26 reported sources of domestic drinking water as springs, creeks or cisterns. Altogether, 171 farmers reported having adequate water supply, while 19 reported that the water supply was usually adequate. In the part of the Ganaraska watershed contained in Hope Township, 30 farmers, however, reported that the water supply was not adequate.

Of the 68 farms in Clarke Township, 49 farmers reported dug wells, 9 reported drilled wells, while 10 reported no wells at all. In Clarke Township, 53 of the farmers reported an adequate water supply, 7 reported a supply that was usually adequate, while 8 had an inadequate supply. Many farmers also reported more than one source of water supply.

In Hope Township 69 farmers reported they used the same well for stock purposes as for domestic purposes; 53 had wells in the barnyard, while 83 farmers had creeks running through their property; 64 reported one or more springs in their pasture fields, while 5 farmers had natural ponds on their farms, and 33 farmers had cisterns in their barns.

Similar information for Clarke shows that 21 farmers used the same well for stock as they used for domestic purposes, 12 used another well, 31 had creeks running through their property, 12 reported springs, one reported a pond, while 20 of the 68 farmers reported cisterns.

2. THE RIVER AND ITS TRIBUTARIES

The Ganaraska River is not large in comparison with some of the other rivers in southern Ontario. The area drained by the whole river system is 103 square miles (65,911 acres). In comparison to this, the Grand River has a drainage area of 2,600 square miles; the Thames River a drainage area of 2,220 square miles; the Humber a drainage area of 220 square miles; and the Moira a drainage area of 1,090 square miles.

Numerous headwaters of the river which commence at the base of the back slope of the moraine are fed by deep seepage from the uplands.—The 8th Concession of Clarke.

The river is unique, however, in that its headwaters all rise at the base of the moraine which, as already pointed out, consists of land for the most part of low agricultural value. For this reason, the headwaters can be more economically controlled by reforestation than had the areas been of good agricultural value; moreover, these areas are splendid examples of the relationship between forest denudation and intensity of run-off.

The whole river system is made up of an extensive ramification of tributaries, consisting of two main branches and innumerable smaller ones. The main branches have been separately named and one of these, known as the Ganaraska River proper, takes its rise in the upper part of the 8th Concession of Clarke and empties into Lake Ontario at the town of Port Hope, after traversing a distance of twenty-one and three-quarter miles. The other large branch, known as the North Ganaraska, takes its rise in the 7th Concession of Hope and joins the main branch at Canton, after traversing a distance of ten and a half miles. Of the many tributaries to these main streams, ten have local names, and of the small branches joining these tributaries, thirty have also been named. These carry, in most cases, the names of the original owners of the properties through which the streams run, or in some cases are named after the owners of the mills located on the streams.

The drop in elevation of the river in relation to distance is greatest at the headwater streams.[1] For example, the main river which commences in Carscadden Creek drops 406.4 feet from its source to the bridge on the Sixth Concession road near Kendal, a distance of 4½ miles. From this point it drops 340.8 feet to Lake Ontario at Port Hope,[2] a distance of 17¼ miles. The drop in elevation of the other headwater streams is more or less the same, as shown on the accompanying profile of the river.

Such steep gradients at the headwaters of these streams have a direct bearing on the rate of run-off, especially during periods of heavy precipitation.

The normal width of the river varies appreciably at different points, and while such measurements taken at random along the tributaries are more or less meaningless, some idea of the average width of the main branches can be gathered by giving the lengths of some of the bridges, which presumably were built to take care of the normal flow of water in the river at these locations. On the Kendal-Campbellcroft road, which intersects seven branches of the river, the bridges at five of the largest branches, starting from east to west, are respectively: 24 feet, 24 feet 1½

[1] Elevation from nearest contour line on Military Map.

[2] Difference between B.M. 249.7 at Port Hope and level of Lake Ontario, May 1st, 1943, was 3.1 feet.

inches, 9 feet 11 inches, 11 feet 8 inches, 9 feet 8 inches in length. On the 6th Concession of Clarke just south of Kendal the bridge is 24 feet in length. On the 6th Concession of Hope, or Perrytown road, which intersects three of the main branches, the bridge at lot 19 is 40 feet in length. At Canton, on the main stream, the bridge is 40 feet long, and where the provincial highway crosses the river, between Welcome and Dale, the bridge is 78 feet long. In Port Hope, however, where the bed is formed by the outcropping of underlying Trenton limestone, the length of the bridge is only 42 feet, with a clearance of 11 feet.

It is not possible to give any accurate figures as to the volume of water coming down the river at different periods, due to the fact that no gauging stations of any kind have been established, but in the Flood Prevention Report of James, Proctor and Redfern, Consulting Engineers, which was prepared by them for the town of Port Hope in 1937, for the purpose of recommending flood control measures, the volume of water passing through Port Hope at flood periods is estimated at "10,000 cubic feet per second."

All the primary tributaries of the river have their source on or at the base of the morainic slope. In some cases, notably the group of headwaters on the 8th Concession of Clarke, just north of Kendal, they rise directly from springs at the base of the sand dunes in open country, which springs undoubtedly are fed by deep seepage. These streams pick up volume very quickly and through the years have worn deep gullies down the slope of the moraine.

Many branches of the river take their rise in swampy and wooded areas, which are common at the headwaters and along the river's course. In fact, there is more swamp and woodland along the whole course of the stream, in the better agricultural land, than one would naturally expect. These fringes of forest not only feed and protect numerous springs, but also protect the banks of the rivers against erosion.

The influence of tree growth on the stream flow is emphasized also by the fact that on old maps of the area, notably Tremaine's Map of Durham County, 1861, and the Historical Atlas of the Counties published in 1878, the headwater streams extend much farther up the morainic slope, which at that time was well wooded. Many of these dried-up water courses can still be followed, and these probably help to increase the rate of run-off on this part of the watershed at certain seasons of the year.

Another interesting feature of the river is the many disappearing streams which are found. These usually take their rise in a small swamp or woodland, and after gathering volume suddenly disappear into the underground layer of coarse gravel. Several of these are shown on the accompanying map.

Photograph by A. R. A. Taylor.

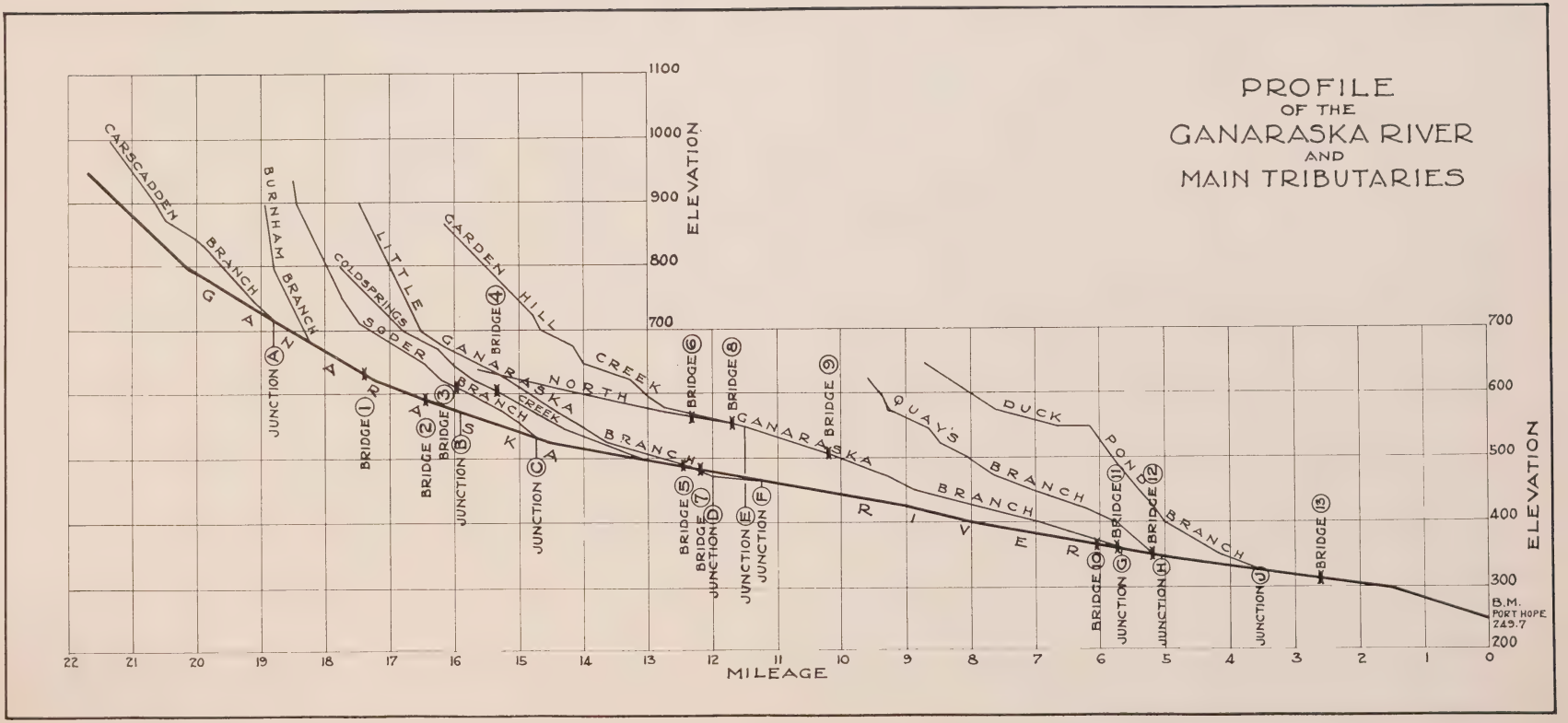
In some instances the rapid run-off has gouged deep gullies in the terrain—The headwaters of one of the main branches of the Ganaraska River on the 8th Concession of Clarke.

No natural ponds occur on the area, although a few artificial ones are found at dam sites and where old dams were once in place.

No rapids of note occur, although on the upper reaches the stream flow is rapid over pebbly beds, due to the sudden drop in elevation. At Port Hope, where the river passes over a rock bed, it reaches the nearest approach to a full rapids.

3. WATERPOWER

The Ganaraska River was early utilized by the pioneers for water-power—mills being constructed on its banks and dams thrown across the swift waters of the river at various points on the main stream and its tributaries from the earliest days of white settlement. To get an idea of the swiftness of the river, its power potentialities, and the probable effect which the presence of dams has had on the state of the river, it is necessary to see what dams have been in operation in different years throughout the last century and a half since the first one was constructed.


PROFILE
OF THE
GANARASKA RIVER
AND
MAIN TRIBUTARIES
ELEVATION
MILEAGE
CARSCADDEN BRANCH
BURNHAM BRANCH
COLDSPRINGS
LITTLE SOCER
GARDEN HILL CREEK
GANARASKA NORTH BRANCH
GANARASKA CREEK
GANARASKA BRANCH
GANARASKA RIVER
QUAY'S BRANCH
DUCK POND BRANCH
JUNCTION A
JUNCTION B
JUNCTION C
JUNCTION D
JUNCTION E
JUNCTION F
JUNCTION G
JUNCTION H
JUNCTION J
BRIDGE 1
BRIDGE 2
BRIDGE 3
BRIDGE 4
BRIDGE 5
BRIDGE 6
BRIDGE 7
BRIDGE 8
BRIDGE 9
BRIDGE 10
BRIDGE 11
BRIDGE 12
BRIDGE 13
B.M. PORT HOPE 249.7

The character of the river in the 1790's may be deduced by tracing the history of the Smith-Walton mill in Port Hope. In 1795, Elias Smith of Montreal had sent his son, Peter, to Port Hope (or Smith's Creek as it was then called) with millwrights to construct a raceway and a combined saw and grist mill structure. Smith and Walton had all water rights on the river in Port Hope and for a mile further north. The site for the mill was selected at the present Mill Street on the east side of the river where the current was very swift and had a drop of upwards of twelve feet as the water poured into the bottleneck near its mouth. The mills were originally designed to be run by race, not dam, and a raceway was carried from about the site of the present Ontario Street Bridge along the side of the eastern hill to the present C.N.R. Viaduct.

In the spring of 1796 when the frost came out of the ground the banks caved in and the whole construction was destroyed. Thereafter the millwrights were engaged to build a dam across the river in order to supply power for the mills which were moved to the river bank.

The Smith-Walton dam, when completed, was a stout log structure, especially reinforced to withstand the force of water and vicissitudes of weather and was in full operation by 1799; and it seems definitely to have been the only dam on the Ganaraska until after 1815.

In order to give a general idea of the number of dams on the river during different periods since early settlement, representative years between 1799 and 1942 have been chosen in which—as closely as could be obtained—the maximum number of dams in each period will be given. The years chosen for this purpose are: 1826, 1843, 1861, 1878, 1910, and 1942.[1]

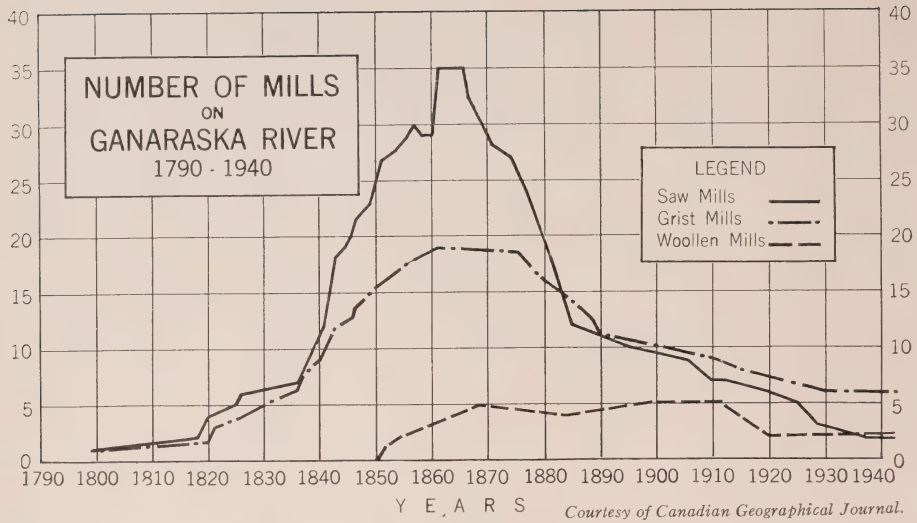
1799-1826

In 1826 the Smith dam was still in operation, and the second wave of colonization in the area, in the decade after the Napoleonic war, brought into existence at least five new mills. These were not confined to the village of Port Hope, but included two on the main river up from the settlement, one on the first tributary of any appreciable size—the Duck Pond Branch—and one on the largest tributary of the river—the North Ganaraska Branch.

1826-1843

As a result of the third wave of colonization which began in the 'thirties, more mills were opened and, by 1843, there were at least eighteen mill dams in operation on the river, exclusive of the six already used by 1826. Of this total, nine were on the main river; two on the Duck Pond

[1]See accompanying map for location of mills and dams.



Courtesy of Canadian Geographical Journal.

Branch; two on Quay's Branch; four on the North Ganaraska and tributaries; and one on the Little Ganaraska.

1843-1861

After 1840 the growth in population in Hope Township and Port Hope was very rapid and, by 1850, the country had passed from a pioneer society to an agricultural and lumbering community. Up to 1861 the growth in the number of mills and dams on the river continued, the land being opened up as far north as the upper waters of the North Ganaraska and the Kendal area of the main river. In this period, of course, mills played a vital part in the opening up of the country and consequently the number of mill dams increased proportionately, reaching a total of thirty-six in 1861. On the main river there were sixteen; Duck Pond Branch, two; Quay's Branch, three; North Ganaraska and tributaries, eleven; Little Ganaraska, two; Soper, one: Burnham, one.

No mill disappeared through failure, and all the early mills on the river were maintained to 1861 with the exceptions of the Charles Henwood sawmill on the main river which, when burned in 1860, was replaced by a smaller Henwood mill on Quay's Branch; and the Harvey Soper mill on the Soper Branch in Clarke Township which was burned in 1859, after which Harvey Soper moved down to his father's mill on the next lot south.

1861-1878

In 1861 the apex of the curve for dams on the Ganaraska is reached and a gradual falling off is apparent after 1865. Not, however, until 1869 is there any appreciable drop in the curve, when between that year

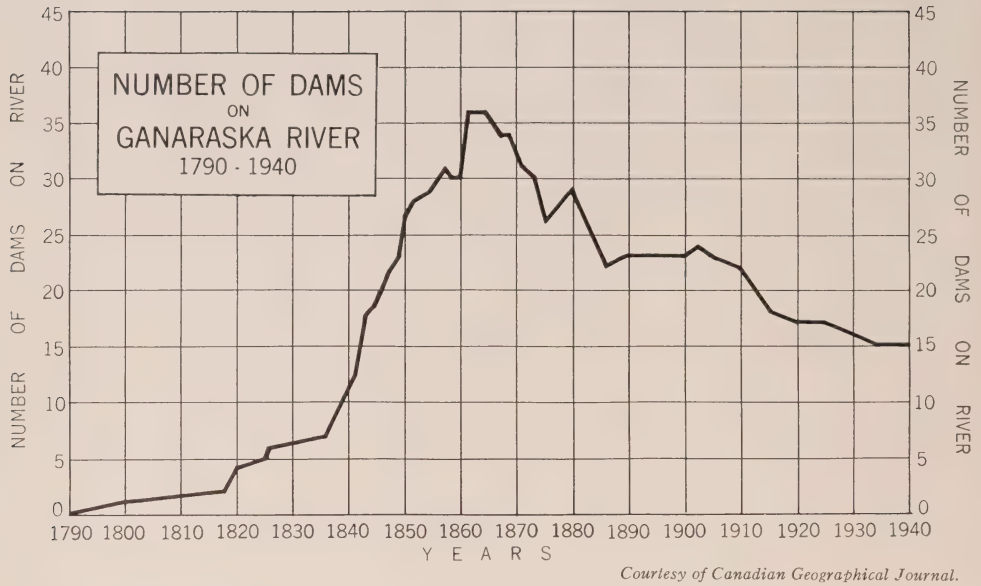
U.S. Forest Service photo.

Early in the settlement of the watershed, the river was used by the pioneers for water-power; a total of 45 mills of different types having been in operation on the main stream and its tributaries.

and 1875 eight dams disappeared. For example, between 1861 and 1878 ten mills had either failed, been burned, or had their dams swept out by flood and were not rebuilt. Of the twenty-seven mill dams and one reservoir dam remaining, thirteen were on the main river.

1878-1910

From 1878 to 1910, a further falling off occurred in the number of dams in operation and, while there were no additions on the main river, four new dams were built on Quay's Branch, Duck Pond Branch, Outram Stream, and the North Ganaraska Branch. Several of these have been retained as fish ponds, when commercial use ended. In addition certain mill dams were kept in operation after milling activity ceased. For example, the old Choate dam became the Corbett Electricity Dam, while on the North Ganaraska Thomas Campbell made an electricity pond to furnish lights for his mills and residence. In 1910, then, there were twenty-three dams on the river, eight being on the main river and five on tributaries.



Courtesy of Canadian Geographical Journal.

1910-1942

Between 1910 and 1942, eight dams on the river fell into disuse; of these the Barrett Dam in Port Hope is now a complete ruin; the Choate Corbett Dam above Port Hope fell into disuse by 1911 when the Toronto Electricity Company bought out Corbett and established the Port Hope Electric Light and Power Company, to control electricity in this area; and the Watertown grist mill at Kendal was abandoned in the first two decades of the new century. The Dean-Patterson Dam on Gray's Creek of the North Ganaraska ran up until about 1935 and this dam remains, as does the Corbett Dam. About 1929, the gates of Soper Dam on Soper Creek in Clarke were opened and it is now falling into ruin. This left four dams on the main river, and eleven on tributaries.

In 1942 fifteen dams were in operation on the river and of these eight serve mills, one is a power dam (Nicholson File, used to start machinery) and six are fish ponds.

4. FLOODS

[a] The Relation between Forests and Floods:

A forest has been described as "a plant society governed by definite natural laws the knowledge of which is basic to its intelligent management as an economic resource." This is true whether the forest in question is a few years old or a few hundred. If we examine a forest

A forest, with an abundance of young growth and a mantle of litter and duff of high absorptive qualities, is most important in regulating water movement on watersheds.

in vertical section what do we find? First of all, there are the crowns of the trees with their dense foliage, either broad-leaved in the case of deciduous trees, or needle-leaved in the case of coniferous trees. Here in the spring are the flowers and later the fruit. Here, too, is a ramification of branches of all sizes supporting the foliage. Here, through the leaves, the work of transpiration and the manufacturing of food for the tree is carried on. Coming farther down are the larger branches, most of which bear fissured or scaly bark in varying degree, depending on the age of the tree. Reaching the ground we observe the roots are composed of growth similar in structure and development to the branches of the crown. These are the anchors which hold the tree in place, and through the root hairs, at their extremities are the essential feeding parts of the tree. But the function of the roots does not end with giving support and nourishment to the tree, since in the act of extending themselves for food they open up the soil and make thousands of small channels into the ground, which greatly increases its porosity.

The forest floor is perhaps the most important biological factor in the forest. It comprises all the growing plants up to a foot or so in height such as seedling trees, shrubs, trailing vines, both ligneous and

herbaceous, a great array of wild flowers, moss and lichens, depending on the type of forest. Beneath this is the accumulation of debris which has gathered throughout the life of the forest; made up of leaves, branches, bits of bark, cones and dead herbaceous growth in different stages of decomposition and pressed down by snow of many winters. This is the forest litter, grading into the humus or forest manure and becoming finer in texture until it mingles with the mineral soil.

The forest floor with its mantle of litter and duff of high absorptive qualities is most important in regulating water movement on watershed areas. Not only because it holds some of the precipitation, thus allowing it more time to sink in or run off, but also because it "maintains the absorption capacity of the underlying soil at its maximum."

This assistance which the forest floor gives to the absorption of moisture by the soil is partly responsible for the feeding of springs and underground storage. Zon[1] gives over thirty reliable references, in Europe and on this continent, as to increase and decrease of water in springs in relation to the presence of forest. As many references could easily be gathered in our own province, from residents in the rural districts. No one, who has lived in wooded areas of Ontario and has watched the forest being cut down over large areas, will gainsay the fact that the water supply in springs has been changed.

Occasionally the statement is heard "Plant more trees and conserve the forest and we will have more water in our streams and rivers." Such a statement is only partially true, and requires elaborating. Actually, a forest does not increase the gross amount of water given off by a watershed in relation to the amount of precipitation, because this would preclude the use of any of the water by the forest itself. It does, however, prevent snow from melting too rapidly in the spring and, through the agency of the forest floor, as already pointed out, holds moisture for absorption into the soil for underground storage, and permits of a less rapid rate of run-off.

By mechanical interference trees are of great assistance in modifying the effect of rainfall. The leaves and branches break the force of the rain. Some of it trickles down the trunks so that much of the water reaches the soil without violence. These same agencies also prolong the effect of rainfall because, after a storm, water may continue to drip from the trees for many hours.

The forest under all conditions cannot be said to prevent floods. Floods are caused chiefly by excessive precipitation and extremes of temperature. The forest, however, generally has a decidedly mitigating influence on floods. From what has already been said regarding the interference to rain by

[1]Raphael Zon, Director, Lakes States Experimental Station, U.S. Forest Service.

Courtesy of Arthur Mark.

The Town of Port Hope has been damaged more than thirty times by floods. In one year the property loss was estimated at $250,000—The flood of March 12, 1936, from the C.N.R. Viaduct.

the trees themselves and the water holding capacity of the forest floor, it can be easily seen that here is a potent barrier to flood conditions. But when the forest reaches the point of saturation and absorption into the ground is retarded, its work is completed and run-off in large amounts will commence. This inability of the forest to absorb moisture is sometimes interfered with by another cause, namely a condition when the ground is frozen and covered with deep snow, then suddenly the temperature rises abnormally and rain follows for several days. In some cases, also, the forest may even add to flood conditions, by retaining in its shade a large portion of the snow cover until the period of spring rains.

[b] Floods on the Ganaraska:

Since the middle of the last century the good people of Port Hope and the settlements lying immediately to the north have been visited periodically by disastrous floods. Each spring, and in fact following a few days' heavy rain, the fear of flood is uppermost in the minds of the townspeople. When severe floods do occur they always cause serious damage to property and to merchants' stocks in the business section of the town. During the flood of 1929 such damage was estimated at $250,000.00. The same year the dam at Canton required repairs in

excess of $20,000.00. Damage in other years was in proportion to the severity of the flood.

In securing information of floods on the river, no effort has been spared in searching out all available records which might have a bearing on this subject. The source for this material includes personal diaries, gazetteers, newspapers, meteorological reports, as well as conversations with people who experienced the floods.

The first flood of which there is any record occurred prior to 1813,[1] as it is recorded that the log bridge on Walton Street was washed out. Also, it is said that this freshet changed the course of the river, which previously was much wider at this point than at present, and to have disturbed the gravel bed which then existed, exposing the shale rock which is so evident at the present time. The record of this early freshet shows that sometimes, even when a countryside is covered with forest, floods do occur.

Unfortunately, from 1813 to 1848 no records of floods have been found, although it is reasonable to assume that these occurred from time to time, and were of more or less severity. The fact that settlement in the area had not progressed very far, up to this period, and little property damage was done, may account for the dearth of records. After this period, however, settlement on the land was accelerated. The forest along the river was opened up and the land was being cropped, and at this time also the timber on the morainic slope was beginning to be cut into severely. Thus the conditions for flooding became more acute and more notice was taken of any property damage which occurred. As an indication that settlement was contributing to flood conditions on the river, we find in the diary of Sarah Hill, who lived on the Duck Pond Branch, the first mention of muddy waters during a spring overflow about 1877, indicating, no doubt, that water was coming from cultivated land.

About this time, also, many dams were built on the river. Most of these were for local mill operation and impounded small areas of water. Such ponds would have had an ameliorating effect on small floods and at such times would have retarded the scouring and erosive effect of the river by checking its speed. They, no doubt, also improved summer flow in the river. However, considering the total acre feet of all the mill ponds, it is doubtful that they would control the river to any great extent in times of severe flood. On the other hand, it is just possible that under certain circumstances the presence of so many dams and ponds on the river might have increased flood conditions lower down the river. These dams were all privately owned, and it is most likely that when the river commenced to rise, each mill owner, fearful that his

[1]Port Hope Historical Sketches, page 18, W. Arnot Craick.

dam might be washed out, would lift the logs in the dam, with the result that the volume of water going down would be increased.

In the town of Port Hope it is well known, too, that flood conditions have been increased in severity due to the volume of ice coming down the river and forming a jam in the channel, or at some of the obstructions which occur along its course, within the town limits.

Space will not permit of reference to the forty different years, from 1813 to 1937, in which records of floods of varying severity have been given. A few of the most severe, selected from different periods, will be sufficient to indicate the damage caused in this way.[1]

1850: Over a general area in the vicinity of Port Hope, a flood occurred, "occasioned by the heavy and incessant rain that fell the preceding night." "The creek . . . rose to an unusual height . . . being at least 10 feet in many places, above the common level." Choate's Dam did not give way, but road damaged; Port of Bedford, "Mill dam carried away with a building containing machinery, etc." "Gillespie Tavern, Woodshed and several cords of wood carried away." "Waddell's mill dam, some damage by overflowing of water on west side." "Number of fences thrown down by current that overflowed the low grounds near the harbour." From *Port Hope Watchman and N. & D. Advertiser*, "The late destructive floods . . . the greatest and heaviest calamity by water that has ever occurred in the Province." "Considering the heavy flood, and the amount of property exposed, the loss sustained in this Town and neighbourhood is comparatively trifling to what it might have been."

1878: January or February. Area general. Caused by midwinter thaw. In Port Hope, Smith brick store building swept away on N.E. side of Walton Bridge, including fruit store and fish market; Walton Street and Cavan Street bridges carried away; fourteen dams wiped out on river, including Beamish Dam, Port Hope.

1883: Friday, July 13. *The Guide*: Area general. "Another heavy thunder storm set in at noon Saturday. The water fairly poured down and ran in rivulets on both sides of Walton Street, large enough to float a boat in. The damage to the crops in this vicinity is very serious . . . Garden Hill . . . a fearful storm was raging . . . Track (Midland Railway) was overflowed in several places to the depth of three or four feet . . . (the train) proceeded carefully . . . at the rate of four or five miles an hour. When coming to a part of the track which was covered with mud, sod and stones, six or eight inches through, (it) backed up again towards Millbrook . . . Between those two places (Millbrook and Garden Hill), it was found the track had been washed

[1]A complete list of flood data will be found in the appendix.

away in several places. At Deyell's crossing a hole on the travelled road had been cut out eight feet deep, and railway ties had been carried forty rods by the flood and thrown on the track. The storm did not last more than half an hour, and such a downpour has not been known in the memory of the 'oldest inhabitant.' The barley and fall wheat fields are all flattened by it. The creek at Canton, too, is overflowing the road. Such a thing has not been known before, unless it had been blocked with ice.

1890: June 30. Area general. Apparent cause: cloudburst and incessant rain "and consequent flood." Weather very rainy. Every bridge on the river washed out; also board sidewalk and part of Walton Street gouged out; child drowned; stores on Walton Street damaged; Walter's Dam washed out; election slated for June 30 postponed until 1st July (Mowatt flood).

1906: Friday, March 30. *The Weekly Guide*[4] "Bridges swept away; Much damage to Residences and Stores: The heavy downpour of rain which lasted all day (Tuesday) and the mild weather combined caused the Ganaraska river to rise and finally overflow its banks. Early Tuesday morning the river was a raging torrent and all day it continued to swell. Finally Gray's dam at Garden Hill gave way and a portion of McCallum's bridge at Dale was carried off. About 5.30 o'clock in the evening the water and ice came along with a great rush and the foot bridge on Walton Street, including the portion between the concrete walk, was swept away . . . The water rushed over the driveway and the stores on the south side of the bridge were badly flooded; furniture and goods were badly damaged. By six o'clock the water had risen to such a height that it was impossible to cross any part of the bridge. Ontario Street was in a similar state. From the bridge near the Ontario House to Walton Street the water was fully two feet deep and large blocks of ice were sailing about in all directions. Cavan Street almost as far south as Walton Street was impassable, and . . . it was impossible to cross the railway track at Walton Street without getting into water up to the knees."

1908: Between March 1 and 16. Area general. Caused by spring thaw and ice. Flood at greatest height during day. American Hotel on Walton Street marooned, ice knocked pillars out from under hotel verandah; Ambrose Brewery filled with ice; houses on Cavan Street flooded; ten houses and small farm buildings carried down from north. Cakes of ice, tons in weight, floating down Queen Street, coming over Walton Street Bridge.

1909: February 24. Area general. Apparently caused by rain and ice. Ice blocked at Choate's (Corbett's). From 1 October, 1908, "season of heavy rains." "The worst flood on record" *Hayden Journal.*

Malting Company filled icehouse from ice cut on Cavan Street. Port Hope: "Considerable portion of wooden buildings on west side of Ontario Street carried away"; "Water in houses on Cavan six inches above floor"; "Lumberyard of G. M. Patterson on the east side of Caven Street immediately below South Street, containing about $1,500 in timber, completely washed out"; a portion of the (cement) walk on Walton Street carried away; only access from eastern bank to western by railway viaduct.

1929: Saturday, January 19. Apparent cause, winter January thaw. "The cause of the flood is attributed to the heavy rain of Thursday when the river swelled its banks and yesterday's driving rain melted the snows which helped to swell the surging waters." Weather cold,

Flooding has increased due to the volume of ice coming down the river and forming a jam in the channel and at some of the obstructions within the town limits,—Walton Street, Port Hope. The small building marks the river channel and the Walton Street bridge. *(See also Page 212.)*

Photograph by W. H. Trott.

with little snow, followed by rain. "Without a doubt, it is the worst flood Port Hope has ever experienced." "Late Friday night and early Saturday morning . . . the Ganaraska river went on its second January rampage." "After a twelve hour torrential downpour, the Ganaraska assumed alarming proportions. As at ten o'clock the muddy waters started to plow down Ontario Street . . . At six o'clock Friday night the water began to rise and at nine o'clock last night reached the bottom of the steel bridge on Ontario Street. At ten o'clock water began to trickle down Ontario Street and shortly afterwards Walton Street resembled a river. The peak of the flood was reached in the early hours of the morning and towards nine o'clock the waters began to recede." "The Ganaraska, with its many northern tributaries, poured tons of water into Corbett's pond. The dam, at this point, has stood the test for many years and helped to stay the onslaught. However, the water surged over the corners of the pond and flowed in a maddening swirl down Cavan Street. This outlet could not convey the overflow and water surged over the western banks of the Pond in a veritable Niagara Falls." Dam at Durham Mills, Canton, damaged, more than $20,000 repairs; "January spree of the Ganaraska, when stores and bridges were carried away, causing property damage to the extent of $250,000"; "Huge cakes of ice were lodged on Midland Railway tracks. Railway traffic completely demoralized"; "Serious damage was wrought in the downtown section when dozens of stores were flooded and heavy loss to stock was occasioned . . . Six stores damaged, houses marooned, driftwood, logs, etc., piled up against the Ontario Street bridge"; "Three stores, occupied by T. J. Mahon, W. Yeomans, Shoe Repair, and W. Smith, Barber, were completely washed away at three o'clock this morning, and a big gap on the south side of the bridge bears silent testimony to the damaging waters"; "The heavy cement bridge at Corbett's Dam was several feet under water and it was utterly impossible for traffic to cross it";"The Nicholson File plant came in for a deluge and the southern end of Beamish's Pond gave way under the tremendous pressure"; "The section south of Barrett Street is completely inundated, and cakes of ice are piled up"; "The Barrett Street bridge, which has been in a somewhat weakened condition, gave way and was carried away in its entirety."

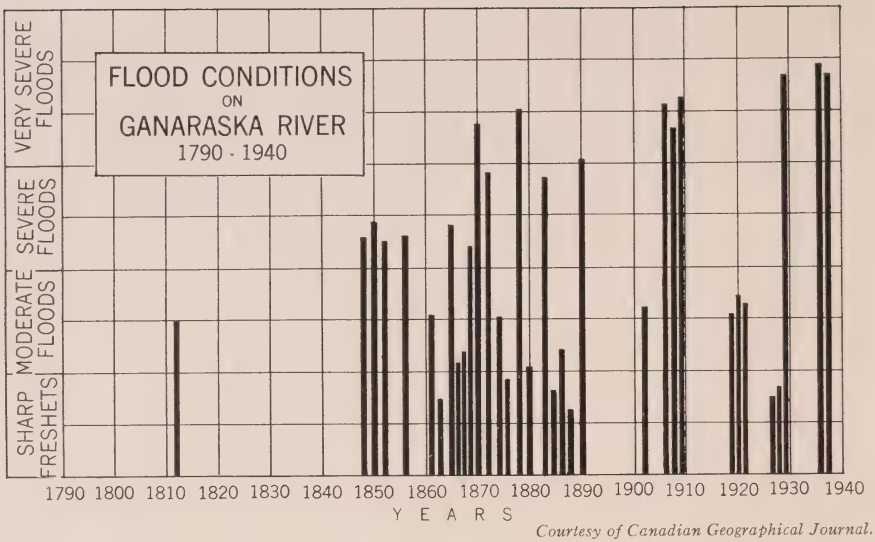
1929: Thursday, March 14. Area general. Weather rainy. Apparent cause, rain or snow. "The rise in the waters of the river is attributed to the snow melting over a large watershed as well as the rain which fell Wednesday night"; "A considerable volume of water is pouring into Lake Ontario"; Reached peak at 3 a.m. and by 8 a.m. "The level had dropped a number of feet"; "A cessation of the rain which fell from early Wednesday evening until midnight lessened the danger and although another precipitation followed this morning, it is not believed to have been serious enough to cause a serious rise in the waters"; "Con-

siderable inconvenience was caused when the water slightly overflowed the banks in a few places—Ontario Hotel stables ten inches." At Nicholson File Company, "Six logs were carried away by the weight of ice and the remaining top logs were lifted. As a result, the surplus water in Beamish's Pond flowed quickly away and the ice sank to the bottom of the Pond and the huge volume of ice further up the stream was held back . . . North of the bridge on the Dale-Welcome highway, acres of ice are held in check, and had the ice fields been carried downstream, serious damage would have no doubt resulted."

1936: March 8 and 9. "Worst jam of ice since 1890's. Took days to get ice off Cavan Street."

March 12. Due to twelve hour torrential rain. "No. 2 Highway. Cakes of ice two, three and four feet deep, five or six in diameter." Deflected branch of angry river hurled itself on the Town Hall. Doors were torn open, stream poured in with ice; water was waist deep in front of the bank. Force of water sufficient to move railway bridge at Beamish's Pond five or six feet out of plumb. Beamish (Nicholson) Dam damaged. Concrete support on Peter Street bridge gouged out.

1937: January 14. Area general. Apparently due to "Heavy rainfall during night causes rapid rise in Ganaraska"; "Port Hope visited by its severest flood and tons of water swamp streets"; "One of the severest floods to hit the town, one in which the residents never saw so much water before"; "Water receded at noon hour"; "With fearfull suddenness, the Ganaraska River went on a sweeping rampage here this morning, marooning many residents and in some instances death was averted by a mere hair breadth"; "9 a.m. waves pounded against Peter Street bridge, which was impassable, and spray came over it"; "Torrential rain started to fall on Wednesday night about eight o'clock and continued until well past daylight this morning. The Ganaraska, fed by its many northern tributaries, did not seriously threaten until 4 o'clock this morning. Between 5 and 6, it was apparent that a severe inundation was on its way. One assisting angle in connection with the trouble was the lack of ice, whereas last year, tons of ice swept through the streets, causing heavy damage"; "Around noon hour a considerable recession in the water was noticed and later in the afternoon the streets became passable." Estimate of damage, $75,000 to $100,000. "Stores flooded and many families marooned"; "The inundation crippled practically the entire town (Ontario and Walton Streets)"; "Communication from one side of the town was severed." (Used Dale-Welcome cut-off.) "Corbett's Pond held back an immense amount of water and it swept down the unused dam, flooding the area around Ontario College of Art Summer School and marooning the family of William Lowes on the north side of the creek. Muddy turbulent water poured into Beamish's Pond



Courtesy of Canadian Geographical Journal.

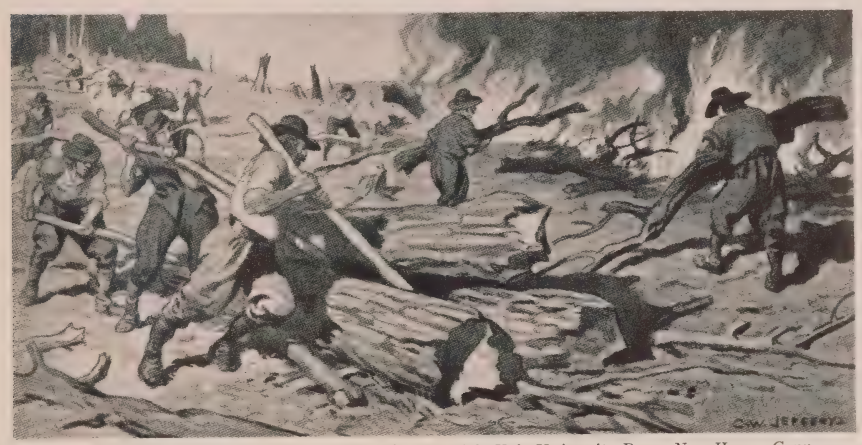
and houses along Caven Street were surrounded by water." "In an effort to assist the flow of water, men attempted to raise the stoplogs at Marshall's (Mill on Ontario Street) and three men were swept off their feet, narrowly escaping drowning. Ontario Hotel management erected large cement walls at the end of their property in the summer of 1936, and the water came nearly to the top of the walls. Water to the depth of two or three feet flowed down Mill and Queen Streets. School was suspended in the Ward."

The accompanying diagram, describes graphically the frequency and severity of floods for which information has been obtained. Actually there is no scientific basis for severity as the quantity of water coming down the river has not been measured at any time. Reports are based largely on property damage and personal observation, and therefore allowance should be made for the personal judgment and volubility of the chronicler. However, from these records it is clear that floods did vary in severity, therefore commencing with this known fact an attempt has been made, based on an examination of the several reports, to group floods into four more or less arbitrary classifications, namely: Very severe floods, severe floods, moderate floods, and sharp freshets.

CHAPTER SIX

Agriculture

THE early development of the small community in the wilderness districts of Ontario followed, in general, the same sequence. First, the pioneers would clear plots for their homes, build log cabins, and make rude implements and furnishings to supplement the small supply which they had brought with them. Then during the first winter and spring they would cut and burn a few acres around their cabins. In the spring they sowed their first crops amongst the stumps.



Reproduced from "The Pageant of America." Copyright Yale University Press, New Haven, Conn.

Early agriculture was of the subsistence type. First the pioneers would clear plots for their homes, then during the first winter and spring they would cut and burn a few acres around their cabins.

In a country where the land was covered with timber it was difficult for the settlers to make a choice of soils, and no doubt the procedure was to accept any land as long as it was close to the lake. The growing of wheat for flour was the chief concern of the early settlers, as before 1800 Simcoe stated that "The product of the earth which forms the staple of Upper Canada must be wheat"; consequently land was valued in relation to its ability to grow wheat. That this was not a true guide is known full well to-day, because many areas on which it is reported large yields of wheat were produced, are now blow sand. The explanation is that following the cutting of the virgin forest, the natural "forest manure" which had accumulated over hundreds of years, provided the necessary plant food to produce crops.

PLOUGHING MATCH.

THE HOPE AGRICULTURAL SOCIETY

Will hold a Ploughing Match on the FARM of ALEX. MORROW, Esquire,

On Wednesday 18th May, next,

Commencing at TEN o'clock of the Forenoon.

Competition open for MEMBERS of the Society, their SONS or SERVANTS. The following Premiums will be awarded, viz:—

FIRST CLASS---MEN 21 years old or Over.

To the Best Ploughman.	-	-	£1 0 0
2nd. Do Do.	-	-	0 15 0
3rd. Do. Do.	-	-	0 10 0

SECOND CLASS---YOUNG MEN 18 to 21 years.

Best Ploughman	-	-	£1 0 0
2nd. Do. Do.	-	-	0 15 0
3rd. Do. Do.	-	-	0 10 0

***Third Class*---Boys under 18 years old.**

Best Ploughboy	-	-	£1 0 0
2nd. Do. Do.	-	-	0 15 0
3rd. Do. Do.	-	-	0 10 0

Each Competitor will be expected to *Plough* about *Half an Acre*, and have it completed at 2 o'clock, and conform to the Rules laid down by the Committee.

Any *Person* intending to *Compete* for any Premium offered by the Society will please *to become a Member Immediately*, as none can be admitted after the 29th of April instant, for the present year.

WILLIAM H. ALLEN,
Secretary.

Hope, 21st April, 1853.

Plowing match poster of 1853—Reproduced by kind permission of Edwin Wilson.

The inadequate preparation of the soil for seeding by primitive methods, and no knowledge of the modern methods of rotation, as well as the lack of fertilizers, soon gave rise to the idea that the soils were exhausted. This was particularly true of the sandy soils, and after a few years of cultivation the pioneers recognized the limitations of this class of soil, especially in the northern part of the watershed, which accounts for the abandonment of much of this land in later years. Referring to this part of the watershed John Squair, writing many years later, states that "These areas (the Ridge and Iroquois beach line) ought never to have been cleared of trees. If they had been kept as forest they would have yielded their yearly crop of wood, which to-day would be very valuable."[1]

Later on, with the raising of cattle and the recognition of the potentialities of the heavier soils farther south, a marked improvement in soil fertility was brought about.

Evidence that the early settlers were interested in improved methods of agriculture is found in the fact that as early as 1830 a meeting was

[1]The Townships of Darlington and Clarke—by John Squair, page 444.

held to organize an agricultural society in Hope Township, and two years later this society imported pure-bred cattle and later an attempt was made to introduce varieties of wheat specially suited to the area. In 1853 the society held a plowing match to stimulate greater efficiency in this art.

Courtesy of "Farmer's Advocate."

In early days land was valued in relation to its ability to grow wheat. Grain was cut with the cradle and bound by hand.

Other staple grains such as oats, rye and barley were grown in early times and after the middle of the last century peas were grown in large quantitiesand were shipped for seed to French and American seedsmens but the depredation, of the pea weavil became so serious that the growing of peas in large quantities had to be, to a large extent, discontinued.

Wool was a commodity of major importance in early years. It was customary for the farmers to make clothing, either from wool to garment, or by having the cloth made at a local mill, of which there were several in the area. Fullcloth and flannel were staple cloths and at the Exhibition of 1848 a local resident was awarded a prize for ten yards of home-made flannel.

Until the middle of the last century it was the common practice to harvest all the crops by hand. Grain was cut with the cradle and bound by hand. Hay was cut with the scythe and raked by hand. There is no evidence that the sickle was used to any extent on the area. Peas were pulled with the scythe. Before the advent of improved farm machinery, grain was threshed with the flail and the fanning was done by hand.

Apples first made their appearance in the region about 1828. Fruit for the most part, however, was not grown commercially at first, but every farmer had a few trees in his garden for home use. That fruit grown in the region was of high quality is evidenced by the record that in 1846 Samuel Wilmot, who lived just to the west of the watershed, was awarded a prize for table pears.

While flour and grain were the major exports, next to timber, much of the grain was used locally. Rye, barley and wheat were used by the breweries and distilleries, and Port Hope whiskey was famous for its quality, not only locally but in England as well. Much of the grain found its way to the local grist mills, which were numerous on the Ganaraska River. The product of these mills was of high quality, as the records show that two farmers in Darlington Township, which is just over the watershed, received medals at the World's Exhibition in 1851 at London, England; one for flour and the other for oatmeal.

When the western wheat commenced to appear on the market, and the large rolling mills came into being, wheat was grown in lesser quantities locally, and the farm output gradually changed from grain only to products of beef and pork, dairy produce, mixed grain for stock-feeding purposes, and apples.

Agriculture on the watershed to-day is of the mixed general type. To the south of the area, in the district of Port Hope, Welcome, Dale and Canton, the majority of farmers practise dairying and the area is included in the Toronto Milk Shed. Many farmers are also interested in apples and canning crops, especially tomatoes, peas and corn, and there are canning factories at Port Hope, Cobourg and Peterborough. In this district, also, clover seed is another cash crop and some have done exceptionally well with Alsike clover seed.

As one proceeds farther north to Perrytown, Garden Hill and Campbellcroft, more general farming is practised, with the majority of farmers keeping dual-purpose cattle, with a few being milked and the rest allowed to raise their calves. Some of this district, particularly west of Perrytown and east and north of Campbellcroft, is quite suited to growing potatoes and a few growers produce several acres of certified seed each year, with others growing a limited acreage for commercial purposes.

In the Osaca district the land is suitable for tobacco growing. During the past four or five years about 2,000 acres of this land have been taken over by the Durham Tobacco Plantations, and for the past two years about 200 acres of excellent tobacco have been grown. A few private individuals also have purchased tobacco farms in this area. In the Kendal district, where the land is rolling, general farming is practised.

CHAPTER SEVEN

Erosion

SOME years ago an agricultural representative examining a hilly section of his territory, saw two men near a rail fence loading soil into a dump-cart. When filled, the cart was drawn up the hill and the soil was spread upon an almost barren knob. With a spade he dug into the earth on the uphill side of the fence, near the spot where the men were digging. He went down almost two feet, before going beyond a rich accumulation of topsoil that had been washed there from the hill. When asked for an explanation, the men said they had a little spare time and they believed it was cheaper to haul the dirt back than to buy stable manure. The agricultural representative estimated that it would cost $500.00 an acre to lug even a six-inch covering of that soil back to the place from which it came.[1]

"Of all the gifts of nature, none is more indispensable to men than soil. Lying over the rocky core of the earth at varying depths, this complex mixture of animal, vegetable, and mineral matter is one of the four prime requisites for life. Along with sunlight, air, and water, soil nourishes all plant life and supports all animal and human life. Without it, this planet of ours would be as barren as the moon."[2]

Since the dawn of time, soils have been on the move. Rain and wind, the two chief agencies in soil erosion, have scoured away continually at the surface of the earth and transplanted soil particles from place to place. Under the natural protection of trees, grass, and other plants, the rate of erosion has been almost imperceptible, while at the same time nature rebuilt new soil, thus providing a balance. When man first started to till the earth this balance was disturbed, and by the use of primitive as well as modern methods of agriculture, farmers unknowingly speeded up the rate of soil erosion.

Although this problem is as old as time and its ultimate damage was realized hundreds of years ago in such countries as North Africa, China and Mexico, its insidious work has not received attention on the North American Continent until modern times. In fact the systematic attack on this problem in the United States dates only from 1935, with the passing of the Soil Conservation Service Act, setting up the Service and

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[1]Adapted from Soil Defense in the Northeast—Farmer's Bulletin No. 1810, U.S. Department of Agriculture.

[2]Soils and Security, by H. H. Bennett; Chief, Soil Conservation Service U.S. Department of Agriculture.

providing for a nation-wide programme of erosion control. In Canada, and especially eastern Canada, the problem is only now being faced.

1. FACTORS AFFECTING SOIL EROSION

The two chief causes of soil erosion are water and wind. In southern Ontario most of the soil transported by wind consists of light sandy types which occur in a few large defined areas, or spotted here and there on the good agricultural land. In the onion growing areas, particularly in the south-western part of the province, the reclaimed peat soils also present a problem. Wind erosion can be controlled by tree planting, either by windbreaks or planned woodlots, and by the use of soil binding crops. Water erosion, however, is more insidious and where large areas of good cropland are involved, the problem becomes very serious, as it strikes at the economic life of the individual and the community.

While water is considered the worst offender where agricultural soil erosion is concerned, other factors such as climate, slope of land, quality of the soil and the land cropping system are also important.

[a] Climate:

Climate includes such factors as temperature, the distribution and intensity of rainfall, the amount and duration of snow cover, and the period during which the countryside is sealed by frost. Where the winter season lasts for a period of four or five months, with heavy frosts and a large amount of snow, as for example on the Ganaraska Watershed, the problem of soil erosion is not so acute as in the central United States, or farther south, where the soil is exposed for long periods of the year, with little frost or snow. Rainfall, on the other hand, has a direct bearing on soil erosion. It is not so much the quantity of rainfall in a given period which causes the damage, as the rapidity with which it falls. A heavy driving rain for a short period is more damaging than a slow drizzle over a long period, although the rainfall may be equal. On the Ganaraska this factor is accentuated by the snowfall, which often melts quickly in the spring and because of the topography runs rapidly into the many stream courses.

[b] Slope:

Every small boy knows that he can travel faster on his sleigh down a steep slope, than on one which is less steep. He also knows that he may start slowly on a hill of gentle slope, but will pick up speed the farther down he goes. Water flows more rapidly down a steep slope than a moderate one, but it is not commonly known that when the speed or velocity of running water is doubled, it becomes four times as effective

Courtesy of O.A.C., Department of Extension.

Sheet washing is the least conspicuous and most insidious type of erosion, and may go on for years without being realized by the landowner.

in scouring the soil surface, loosening small particles, and carrying them away. If this velocity is increased three times, this scouring ability becomes nine times greater.

The carrying power of water, that is, the amount and weight of soil and other particles that water is capable of carrying in suspension, is increased more by increased velocity than is the scouring power of running water. "Doubling the velocity of a stream increases its carrying power sixty-four times," states A. F. Gustafson,[1] "Trebling the velocity increases carrying power to the almost unbelievable extent of 729 times." This increased carrying power of fast running water explains why coarse gravel, large stones, and other debris, are often found in gullies and in the beds of streams.

[c] Soil:

Quality of soil also has a direct bearing on top washing. For example, a coarse sandy or gravelly soil may absorb rain as fast as it falls, whereas

[1]The Control of Soil Erosion in New York, Cornell Extension Bulletin, No. 430, 1940.

a fine soil such as clay, absorbs water slowly and much of it might therefore be carried away, providing the slope is sufficiently steep.

[d] Crops:

The type of vegetation which grows on an area also is a controlling factor. Forests of different ages (for it must be remembered that trees are a crop) are most effective in preventing erosion; grasses and permanent pastures come next; while grain crops are less effective and cultivated crops such as corn and potatoes, because of the periodic disturbance of the soil by cultivation, give least protection.

2. TYPES OF EROSION

[a] Sheet Erosion:

Sheet washing is the removal of thin layers of soil over a part or the whole area of a field. It is the least conspicuous and most insidious type of erosion and may go on for years without being noticed by the landowner, except perhaps that he realizes the crop yield from such a field has decreased from year to year. Frequently this type of erosion causes the colour of the land to change, as the dark fertile soil is washed to lower elevations where it accumulates sometimes to several feet in thickness. At the same time the subsoil on the higher part of the field becomes exposed.

[b] Rill Erosion:

This type of erosion usually follows after sheet erosion, or the two may go hand in hand. Where the slope is sufficiently steep, or where the surface of the field falls into slight natural channels, small rills or water-courses are created after heavy rainstorms, or when the snow goes off in the spring. This is the type of erosion which is frequently noticed first by farmers.

[c] Gully Erosion:

This type of erosion develops where rills have been neglected. It is often started by ruts left by wagon wheels, or wheels of farm machinery, trails of livestock, or even furrows running up and down the slope. Examples of this type of erosion are very common on the face of the morainic uplands of the watershed, where the land is light and the slope is steep. They are also found to a lesser degree on areas of cultivated land. Where gullies of this type reach a considerable size, they deepen very rapidly by waterfall erosion.

Courtesy of U.S. Soil Conservation Service.

Plowing on the contour is easier on man and horses, requires less fuel for the tractor, and increases crop yields 20 per cent and over.

[d] Silting:

While soil erosion is related specifically to the individual farm and it is here that in the aggregate most damage is done, nevertheless where farm land is related to a river system, such as the Ganaraska, with many of the fields sloping down to creeks, which in turn feed the main river, the quantity of silting becomes serious. Early in the history of the watershed reference is made to the river becoming muddy, and this condition has increased in recent years. To-day, in the spring, or after a heavy rainfall, the Ganaraska is perceptibly muddy, with small particles of soil which are carried in suspension and in solution by the river. Once this takes place these soil-particles continue on their journey until they come to rest behind artificial barriers in the stream-bed, such as old dams or abandoned mill-ponds, but a great deal of it continues on to the lake, where it forms silt at the river's mouth.

The amount of silt which is transported in this way, even by a small river, is enormous. One river which is comparable to the Gana-

raska is the West Humber, above the village of Thistleton, with a drainage area of approximately 100 square miles. On March 17, 1942, when the river was in flood, Professor A. F. Coventry took measurements of the flow and the load of silt being carried down. At eleven o'clock in the morning the flow was 4,000 cubic feet per second (earlier in the day it had been higher). If this rate of flow had continued for twelve hours, one-half of all the water that fell on the watershed would have been in Lake Ontario. The estimated amount of sediment was 2,400 tons an hour, a large part of which undoubtedly was topsoil from the surrounding farmland. Furthermore, the river at this point is liable to cease flowing entirely in summer.

The quantity of sediment coming down the Ganaraska has not been measured, as far as is known, by a suspended-load sampler, nor has the composition of the sediment been analyzed, but considering the relation of agricultural land to the river, and by examining aerial photographs of the area taken in early spring, it is evident that an enormous amount of good topsoil, as well as other material, is carried down the river to the harbour each year. In reporting on this, C. C. Jeffery, Senior Assistant Engineer at Port Hope,[1] states as follows: "The materials dredged in 1936 consisted of sand, gravel, stones, which obviously came down the River; and debris of all kinds, such as an automobile chassis, stumps, logs, oil drums, tires and trees. . . . Generally speaking, the materials dredged in the east slip and outer harbour are dark, being silt and clay mixed with sand. The materials dredged in the Lake approach are mostly sand and gravel, light in colour. The amount of top-soil contained in this silting can only be estimated."

Dredging was first carried out in the Port Hope Harbour in 1875, for the purpose of providing sufficient draught to facilitate navigation within the harbour. This is evidence that with progress of land clearing on the lower part of the watershed, even by 1875 a certain amount of soil was coming down the river, particularly at flood periods, and silting up the harbour.

Maintenance dredging in the harbour has been carried on almost every year since then, and during the last eleven years for which accurate data is available, 226,813.25 cubic yards of sand and silt have been dredged from the harbour; an average of 20,619.38 cubic yards per year. It is of interest to note, in comparing the amount of dredging for these eleven years with the flood years, that the largest amount, namely 32,111.85 cubic yards, was taken out in 1936—the year of one of the severe floods. Regarding the work done in this year, Mr. Jeffery continues as follows: "I personally superintended dredging operations at Port Hope in 1936 when, in the early spring, the River caused consider-

[1]Data supplied by the Department of Public Works, Canada.

able flood damage in the business section of the Town, and large cakes of ice were carried on to the main street. The harbour shoaled up to a greater extent than usual; for instance, a bar was formed across the channel at the entrance to the harbour, having minimum draught of 8 ft.; this was due to an evergreen tree having been washed down the River and lodged at this point, indicating that silting from the River caused the shoaling of the harbour from the River mouth out to this point, amounting to 24,000 cu. yds. approximately, or 75% of the dredging. The other 25% of the dredging carried out was in the Lake approach and might reasonably have come from the Lake." "I am, therefore, of the opinion that it is safe to say that 75% of the maintenance dredging carried out by Port Hope is necessitated by silting from the River."

3. METHODS OF CONTROL

[a] Contour Plowing:

Modern soil erosion control on farmland is based on the principle of plowing and cropping land of moderate slope on the contour. By

The new land pattern—strip cropping on the gentle slopes, pasture on the steeper slopes, and woodland on the hills.

Courtesy of U.S. Soil Conservation Service.

Courtesy of U.S. Soil Conservation Service.

Contour plowing and allied practices require the advice of an expert trained in such work, and a plan for each individual farm.

this is meant the plowing of furrows on the level, or following the contour of the land—a contour being a line which joins all points of the same elevation. This type of plowing is in contrast to the method usually followed in Ontario, where the furrows are plowed often parallel to the slope, because the lot lines and field boundaries run in straight lines regardless of the slope of the land. When furrows are plowed up

and down the slope, they form a ready-made channel for the water to run down grade, whereas when plowed across the slope each furrow acts as a little dam to impound the water and thus prevent washing. At first thought this type of plowing may appear more difficult and laborious than the old type, but farmers who have practised it state that it is easier on both man and beast, as well as on fuel consumption by a tractor. Records filed with the U.S. Soil Conservation Service from thousands of farmers using this method show that in addition crop yields are increased twenty per cent and over.[1]

Where the field has sufficient slope so that contour plowing alone will not safeguard against sheet erosion, other methods, all of which are based on the principle of the contour, are used.

[b] Strip Cropping:

Strip cropping is a system under which ordinary farm crops are planted in relatively narrow strips across the slope of the land, and so arranged that strips of crops which permit of some erosion, such as corn and potatoes, are always separated by strips of close-growing crops which prevent erosion, such as grass, legumes, and grain. Although this method of farming for the prevention of soil loss has been given prominence in recent years, it has been practised for a long time in some parts of the eastern United States by farmers who brought the method from Europe.

The width of strips used varies, depending on the length and steepness of the slope, the texture of the soil, the rate of absorption of water by the soil, and the type of crop grown. In other words, each farm, and in most cases each field, requires separate planning.

[c] Grassed Waterways:

On many sloping fields there are areas which form natural channels for water. Year after year the water rushes down these draws and if sufficiently steep, may result in the formation of gullies. On gentler slopes they form passageways over which severe sheet erosion takes place. Such areas should be left in grass or seeded down to a mixture of grain and legumes. In this way they form a permanent channel or waterway for excessive water, and where they are of sufficient size, can be cropped for hay.

[d] Terracing:

Terracing, as applied to farmland for the control of soil erosion, is used on fields of long gentle slope. The terrace follows the contour and

[1] Dr. H. H. Bennett—Before the Ontario Agricultural Enquiry Commission, Feb. 10th, 1944.

suggests, in construction, a wide, curved, banked highway. These are built at stated intervals down the slope. In this way the slope is broken into a series of short slopes, instead of one long slope. Usually the excess water which is caught on the terrace is carried off by means of a special terrace outlet. Terraces require careful planning and special machinery for construction, and few areas on the Ganaraska Watershed lend themselves to this type of farming.

[e] Gully Control:

Where gullies occur, it is necessary first of all to check the sudden rush of water in the early spring, or at other periods of the year, by building small inexpensive check-dams across the gully. These are usually built with the top of the first dam level with the bottom of the second dam, and have the effect of compelling the water to walk, instead of run. They may be built of any material which is at hand, such as stones, logs, lumber, or even sod. If more staple materials are not on hand, fences may be erected of old wire, or chicken wire, and backed up with brush or straw. In most cases such areas will have to be planted with trees or shrubs, but where they are shallow and form a part of a good field, they may eventually be grassed over.

[f] Stubble-mulch Farming:

Stubble-mulch farming consists of disking or otherwise working the surface of the soil and leaving much of the crop residue exposed. It also includes subsurface tillage, which cuts under the surface, raising and loosening the soil but not turning it over. Such a method helps to control wind and water erosion and conserve moisture. It also leaves the organic matter to decay on the surface as nature has always done.[1]

Mouldboard plowing is based on the theory that soil is built up by burying sod, manure, and rubbish to increase the depth of topsoil and mix organic matter with the soil. Such plowing exposes soil to wind and water erosion, but this can be held to a minimum by contour tillage, strip cropping, or terraced fields. Where there is adequate moisture, nitrogen, and warmth in the soil, crop residues decay rapidly when turned under with the mouldboard plow.

Both of the above methods are advocated by the U.S. Soil Conservation Service, depending on the type of soil, climate, kind of agriculture, and other factors. Stubble-mulching in its many forms is especially recommended in the semi-arid areas and the "dust-bowl" of the southwest. The mouldboard plow is still used in the more humid cornbelt and other areas where it is necessary to break up heavy sod, turn under luxuriant growths of green manure, and control weeds.

[1]See "Plowman's Folly" by E. H. Faulkner.

CHAPTER EIGHT

Wildlife

SALMON, speckled trout, sturgeon, passenger pigeons, grouse, beavers, muskrats, raccoons, hares, wolves, deer, bears—all these were found throughout the Ganaraska area before the white man came, and the keeping of historical records. To-day, Lake Ontario salmon and passenger pigeons are extinct; the sturgeon fishery, at the river's mouth, is comparatively insignificant; bears are gone; beavers, deer and wolves are almost extinct locally; speckled trout, grouse and hares are greatly depleted.

1. THE PIONEER PERIOD

The name Ganaraské, according to J. N. B. Hewitt, eminent authority on the Iroquois language, "probably means at the spawning-place." He says the river is "believed to have derived its name from the abundance of salmon in this locality when the Iroquois wrested these hunting-grounds from the Huron."[1] Although the Ganaraska itself derived its Iroquois name from the salmon once inhabiting the area, it was the existence of beavers which brought it first into the pages of history; and it was salmon and beaver which brought the Indians to the area at least within modern times. For many years it would seem that the beaver had made this river his home, for, in addition to the marshy lagoon at the river's mouth, there were numerous flooded stretches on the river which probably were beaver swamps. Some of these remain flooded to the present day, while others have either dried up naturally or been drained since settlement began in 1793. Beaver meadows also occur throughout the drainage area; and beavers played an important role in the drama of early settlement on the river.

As the presence of beavers originally attracted the Huron trapper to this region, it was the presence of beavers, too, which induced the Iroquois to contest the ownership of the north shore of Lake Ontario with the Huron in 1639. Remy de Courcelles in 1671 states concerning the beaver on the north shore of Lake Ontario: "They (the Iroquois) are . . . forced to range out of their own Territories, in quest of Beaver in the winter time, either towards Ganaraské (Port Hope), or to the sides of the Lake of Toronto, or else towards the greater River of the Outaouas (Ottawa)"[2] and again, writes Percy Robinson of this period:

[1]The Canadian Historical Studies, Toronto During the French Regime, by Percy J. Robinson.

[2]Remy de Courcelles au Lac Ontario, Margry L., p. 180; Lahontan, Some New Voyages in North America, p. 323.

"The Iroquois never hunted the beaver on the south side of Lake Ontario for the very sufficient reason that they had exterminated them there long ago, and that it would be extremely difficult to discover a single specimen in the Iroquois country; they did all their hunting on the north shore of the lake, where the Hurons had formerly hunted."[1]

By 1673, it would seem that, although the beaver may still have been plentiful, the accent had shifted from beaver to fish; for on the French map of that year, an illuminating side-note appears opposite the name Ganaraské. To quote: "Les Iroquois font leurs pesches dans tous les marais ou estanges qui bordent ce lac d'ou ils tirant leur principale subsistance." (The Iroquois carry on their fisheries in all the marshes or ponds which fringe this lake to which they owe their principal subsistence.)

[a] Salmon and Sturgeon:

The Ganaraska, teaming with salmon in the early days, supplied the settlers at the river's mouth with quantities of food. It took no sportsman's skill in those days to land the salmon, since spearing by torchlight was the usual method employed.

Two stories of early fishing give some idea of the quantities of salmon in the Ganaraska about 1800. The first tells how, in 1801, James Sculthorpe, together with an uncle, speared three hundred salmon in one evening for which the two men refused fifty dollars. The second describes how Sculthorpe—who was the famous fisherman of the settlement—and a youth named Taylor, one evening entered the cove near the mouth of the river. Taylor—who was subject to convulsions—had a fit and fell overboard, upsetting the boat. Finally, he was found on the hillside to which he had crawled and, during all this commotion the fishing boat was forgotten. The following morning it was found half a mile downstream, lying bottom up on the shore. Upon turning it over, it was found that thirty-two fine salmon[2] were wedged into it—presumably under the seats. The shoal of salmon, probably having been alarmed by the commotion on shore, had rushed downstream carrying the upturned boat with it.

Sturgeon also supplied the settlers with much food. The Indians probably taught the whites how to capture this mammoth fish, which takes twenty-two years to reach maturity and is at that time approximately three feet long.

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1 The Canadian Historical Studies, Toronto During the French Regime, by Percy J. Robinson.

2 The salmon, once so plentiful in Lake Ontario, ichthyologists have stated, were probably land-locked salmon which spent their whole lives in fresh water. It is presumed that the species came originally to the Great Lakes when they were an arm of the sea.

Adapted from "Picturesque Canada."

It took no sportsman's skill in those days to land the salmon since spearing by torchlight was the usual method employed.

[b] Game Birds:

Most spectacular of all the game birds which frequented the Ganaraska when the white man first settled was the now extinct passenger or "wild" pigeon. In its migrations to and from the south, this species passed over the area in such numbers that, during the flights, the sky was literally darkened by them.

During the spring flights—which usually took place in the month of April—great flocks of the birds, breaking away from the main body overhead, would swing earthward and, like falling leaves, scatter on fields, settle on old rail fences or flutter into the beech woods. Fall movements, according to Margaret H. Mitchell, in her treatise, "The Passenger Pigeon in Ontario," "were much more wandering and unorganized. Apparently after the nesting season the birds scattered in small flocks over the country, drifting about in search of food until the cold weather, sometimes congregating in fairly large numbers in favourable localities. . . . For instance, there were great roosts in Durham

County, Darlington Township, where, in August and September, there came myriads of birds and from which there appears to have been a general exodus towards the end of September."[1]

Apart from the migratory flights over the area, nesting and roosting colonies of the birds occurred in Durham and Northumberland Counties,[1] and this fact would account for their great abundance in the area. Some of these roosts were used for several years, as shown by one occupied from 1856 to 1866 in Darlington Township.

History records the significance of this bird in the economic life of the pioneers; and, as early as 1785, Colonel Henry Hope, from whom the Township of Hope takes its name, had written to Lord Sydney: "The quantities of wild pigeons and fish, which are taken in abundance during the same period (June 1st to September 1st) will contribute to their support, and I conceive an allowance of one pound of flour per day for grown persons and half that quantity for those under ten years would enable them to live on their lands to the 1st of September, after which the crop of that year will abundantly support them.' It has also been said, 'During the flight of these pigeons which generally last three weeks or a month, the lower sort of Canadians mostly subsist on them.' "

In describing the taking of the passenger pigeon, it is stated that: "Although the commonest method of taking pigeons in the province was by use of the gun, the net was employed to a considerable extent, and evidently in several different ways. . . . Besides netting there were many other methods used to capture pigeons. Trapping was done to some extent. . . . Pigeons had a habit of sometimes flying very low over hill tops, barn roofs or other eminences, and people often posted themselves at such points of vantage and knocked the birds down with clubs, poles or branches. This was apparently done quite commonly. . . . Wm. Pope refers to it as a way of taking tired birds that flew very low after crossing Lake Erie. . . . Roosting birds were also knocked from the perches by sticks . . .; and young birds were taken from the nests either by day or by torch light at night. . . ."[2]

Scarcely less conspicuous in this early land of plenty were the migrant duck and goose, although it does not seem that they were taken in such large numbers as the pigeons. They received little or no special mention by writers of the period.

The native grouse, on the other hand, was the all-year game bird for the settlers, and the numbers of these birds were commented upon by travellers. On the Ganaraska, it would seem that the ruffed grouse

[1] See Passenger Pigeon Table in appendix.

[2] "The Passenger Pigeon in Ontario"—(Worked up from Mitchell treatise and diaries of the period.)

FLIGHTS OF THE PASSENGER-PIGEON IN AN AMERICAN WOOD.

Courtesy of the Royal Ontario Museum.

"Flights of the Passenger-Pigeon in an American wood"—From "The Saturday Magazine, January 9, 1835, London, published by John W. Parker, West Strand; and sold at all book-sellers."

(birch "partridge") was the common species, although the Canada or spruce grouse (fool hen) also may have occurred.

[c] Fur-bearers and Game Mammals:

At the time of the coming of the white man to the Ganaraska, the Mississaugas then inhabiting the area lived principally by fishing and hunting, and the settlement was in the heart of a cedar wood, while in the surrounding country there was a great abundance of deer, bear, hares and grouse.

A record in the "Transactions of the Royal Canadian Institute, on the Eastern Timber Wolf, states that as early as 1796 "The wolves, thirty or forty in number, ranged themselves on each side of the sand-bank snapping and howling like a lot of furies to see them (some settlers) escape."[1] For a generation after this they were abundant on the Ganaraska. In the 'thirties, much of the northern area of the watershed was still virgin forest with only here and there a small clearing. For ex-

[1]Transactions of the Royal Canadian Institute, October, 1940, Vol. 23, P. 1, p. 88.

ample, in 1832, settlers arriving at Elizabethville found the district practically in its wild state. Legends still tell of the wolves stalking and howling around the cabins at night with great persistence.

When the permanent white settlers arrived, Harris was carrying on a trade in furs and made trapping expeditions up the river. Although it is presumed that muskrat, raccoon and mink would have been the staple furs, it is probable that some beaver, as well as a certain percentage of foxes, may have been still on the watershed. The native red fox, however, is an animal of the open country more than of the wilderness and up to 1820 would not probably have been very plentiful. By the 'thirties, however, on the lower and settled reaches of the river, there may have been an increasing number of foxes.

2. THE INDUSTRIAL PERIOD

[a] Depletion, then Extinction of Salmon and Passenger Pigeons:

From the 'forties to the 'eighties, great changes took place on the watershed; the land was becoming generally cleared and farmlands were taking the place of forest lands. During this period, wildlife decreased in abundance—at first gradually, and then with more rapidity—until, by 1870, several native species had been so diminished that they were facing local extermination, while the once abundant Lake Ontario salmon and passenger pigeon were facing absolute extinction. Says J. R. Dymond, Director of the Royal Ontario Museum of Zoology: "Although the domestic overuse of salmon and of pigeons in the early days was serious, the destruction of the natural conditions necessary to their existence was probably a more important cause of their disappearance. The cutting of the forests in which the pigeons nested and the change in the size and nature of the streams rendering them unsuitable as spawning places for the salmon, led to the elimination of these species."

In the 'seventies fewer and fewer salmon were being reported caught and the last date given for the occurrence of salmon in Lake Ontario is about 1895.

By 1870 the once annual flights of great bodies of pigeons had become a thing of the past, although it is reported that, from 1882 to 1884, there were "still scattered flocks" seen passing over Northumberland County. Their last reported appearance in Durham County[1] was 1881, when John W. Dutton recorded that there was "a stray pigeon or two about in September." The passenger pigeon in its wild state was practically extinct by 1900—the last pigeon living in captivity died in 1914. Since the passenger pigeon was indigenous to North America only, upon its destruction in this hemisphere it was lost to the world at large.

[1]Near Bowmanville.

[b] Diminution of Other Species:

The systematic destruction of wildlife in the country began to take its toll of other species as well and, from 1860, there are references to their general decline in numbers. It may be pointed out, nevertheless, that apart from the disastrous over-fishing, over-hunting and over-trapping, there was another reason for the lessening in numbers of certain species within different areas. Under original forest conditions animal habitats were vastly different from the habitats existing in the agricultural area on the watershed by 1860; and hence the species which were forest animals would naturally have been reduced. Only in the more northerly sections did such species continue to exist in numbers.

As the forest was cleared and more open living conditions were produced, birds such as the grouse that make their homes in openings in the forest, and mammals such as the native varying hare (snowshoe "rabbit"), and deer would tend to diminish in numbers, while such open country species as the fox would be expected to increase. This sequence was followed on the Ganaraska in the years from the 'fifties to the 'seventies.

In glancing at a check list from John Squair's history of "The Townships of Darlington and Clarke" which covers an area just south of the Ganaraska Watershed, fish, birds and mammals generally show a marked decline in comparison with their early status. Salmon still survived in the area but in very small numbers; speckled trout were quite plentiful although growing only to about six or eight inches in length, except in the tailraces of mills and such protected spots where they could reach the weight of two or three pounds.

As regards birds, the passenger pigeon was practically extinct; grouse still existed in considerable numbers and bob-whites were rare. The migrant plovers, snipe and woodcock returned in appreciable numbers each summer, and the passing ducks and geese were becoming more valued than formerly when there had been such an abundance of passenger pigeons.

Although the bear had been exterminated locally before this time, other furbearers still ranged the area in some numbers. The muskrat and raccoon were the most plentiful of these, while the mink still occurred, although rarely. Foxes and skunks alone seem to have increased in numbers, they being more adapted to life in open country than the other species. Small mammals occurred in numbers, including several varieties of mice, bats and moles; and the squirrel family was also plentiful. It included five species: the flying, red and black squirrels, the chipmunk and the woodchuck (groundhog).

The native varying hare still survived in considerable numbers but, within the decade prior to 1870, it had shown a decrease. About this time, or a little later, the cottontail arrived. With the clearing of the land it spread from the west, but the date of its appearance in Durham County can be given only approximately. Some authorities state that it came in the 'seventies, but this is in doubt since there is evidence that it had not reached Toronto until the 'eighties. Cottontails increased in numbers as land clearing became more extensive, and their increase was not accepted as an unmixed blessing since they girdled young fruit trees. The meadow mouse, too, was considered to be destructive of crops.

Lynx, wolves and bears were scarce in the 'seventies, but the deer was still plentiful—although the great days of the graceful white-tail on the Ganaraska were approaching their end.

3. PRESENT WILDLIFE ON THE WATERSHED

At the present time many of the original or native species of animals (fish, birds, and mammals) once living in great numbers within the drainage area, are now gone or greatly depleted in numbers.

From consideration of records taken by the provincial Department of Game and Fisheries, the Royal Ontario Museum of Zoology and from the reconnaissance survey reports on the Ganaraska done in the summer of 1942, the following general statement on the status of wildlife may be made.

[a] Fish Life:

In the main river from its mouth to a point five miles north of Port Hope, minnows, Johnny darters and the young of the common sucker are the only species commonly found in the summer; the species of minnows being—by Museum record of 1921—bluntnose, creek chub, creek shiner, and blacknose dace.

Farther up the river and in numerous of its tributaries, speckled trout were recorded in 1927 by the Department of Game and Fisheries, while considerable numbers were reported caught in the headwaters of the river and its northern tributaries.

It is stated by residents of the district that native trout were, by 1880, gone from the southern waters of the rivers and were, by 1890, very scarce in the northern reaches. It is generally accepted that, with the

The Ganaraska River in its middle reaches is well protected with trees. Further improvement of the tributaries would provide good fishing.

shrinkage of streams themselves, trout become restricted to fewer and fewer areas and the sizes to which they grow smaller and smaller. J. R. Dymond states: "Since the size of the trout depends on the amount of food available, which in turn is to some extent a function of the size of the stream, the shrinkage of the streams brought about a decrease both in the numbers and in sizes of the trout, but the Ganaraska River contains typical trout water and, undoubtedly, there has been an improvement in the past fifteen years as a result of stocking by the Department of Game and Fisheries and by private individuals and through more effective control by government and citizens alike."

The stocking programme carried out on the river, as shown in the distribution table[1] supplied from records of the Department of Game and Fisheries, shows that much planting of trout has been done in the

[1]See table in appendix.

Ganaraska since 1925. Even after extensive plantings, however, one cannot say that speckled trout are plentiful in the Ganaraska except in particular ponds and in the upper reaches of the river.

The European or brown trout—a species believed to be more adapted to life in such an environment as that found in the lower waters of the Ganaraska river to-day than is the native speckled trout—was planted in the river and its tributaries by the Department in 1933 and 1934. In 1933, approximately six hundred and seventy-five yearlings were planted in the lower waters of the river; and, in 1934, about the same number of yearlings and adults. Only an occasional brown trout has been reported to have been taken by angling in the river, and, in explaining this fact, J. R. Dymond states: "Where brown trout have access to large bodies of water, they frequently leave the streams in which they are planted. At least three brown trout have been taken in fishermen's nets in Lake Ontario."

[b] Bird Life:

Native species of game birds on the watershed, of which there were in the 'seventies at least eight, fall naturally into three classes; the permanent inhabitant, the migratory bird which stays in the area during the summer season, and the migratory bird which merely passes through the country on its way to nesting places farther north.

Among the native game birds, the grouse and the bob-white fell into the first class; the pigeon, because of its nesting colonies in the area, and the snipe and woodcock came into the second group, while most wild ducks, geese and plover were mere transients on the watershed. To-day, of these eight types of game birds, the passenger pigeon is extinct, the bob-white is gone, snipe and woodcock occur only sparsely, plover, ducks and geese exist in reduced numbers since they probably find the area no longer an inviting stopover on their seasonal migrations. L. L. Snyder states: "The ruffed grouse, once generally distributed in the area, now occurs locally in suitable habitats. Periodically it may become fairly numerous in these situations, however."

Certain species of animals fall prey to disease in cycles, which accounts for their periodical fluctuations. Grouse, for example, fall prey to a disease in approximately ten-year cycles, which spreads through the entire population, killing off a large percentage of the birds. For five or six years after this they are scarce, but then are plentiful for three or four years before the epidemic attacks them again.

Introduced animals have now become abundant. The self-introduced cottontail is now plentiful; the spreading of pheasants, Hungarian partridge, English sparrows, starlings and European hare (jack rabbit)

has been extensive, and the direct local introduction of the European or brown trout has been accomplished.

The pheasant and partridge are certainly better adapted to life in open country than the native grouse and, although the grouse is still found in considerable areas where there is suitable cover and food for it, its distribution is, and must of necessity be, restricted in the agricultural areas of the Ganaraska.

[c] Furbearers and other Mammals:

Furbearers on the watershed are seriously depleted with the exception of the muskrat, red fox, and skunk. The muskrat may be said to be generally distributed especially in marshy areas, while the red fox in recent years has become quite common, one man having trapped thirty-three in the autumn of 1940-41. Skunks, generally, have been reported increasing over the area in the past few years, and seem more common than formerly. The increase of these three species in specific areas, particularly Manvers Township, has been reported since the planting of the Durham Forest.

The beaver, which is presumed to have been locally exterminated in early days, has come back, at least in one place; two beavers being recorded at the north end of a pond on lot 18, concession V of Hope Township since 1940. Raccoons occur sporadically, six having been reported trapped in concession VII of Clarke Township during the winter of 1941. The weasel is not common to-day, and mink occur in small numbers along watercourses.

Reports of small animals show the meadow mouse periodically occurring in such numbers that they are injurious to young fruit trees and to crops generally, while the brown rat causes some damage, as it has all over the continent since it introduced itself from sailing schooners in early days.

The native varying hare is practically gone from the Ganaraska. Once generally distributed over the area, it is now confined to the few large cedar swamps remaining, particularly in concession IX of Hope Township. The self-imported cottontail is not particularly abundant to-day, but the recently introduced European hare (jack rabbit) is on the increase. The European hare, originally introduced at Brantford in 1912, had travelled east to Durham County by the early 1930's and this species has, in large part, taken the place of the native hare. It is not, as is the varying hare, subject to drastic fluctuations in numbers, or periodicity caused by disease epidemic.

Big game is non-existent in the area, deer—considered to have become non-existent some time ago—are said to be returning. Wolves,

bears and lynx are considered to have been killed out—although natives have reported in recent years having seen or heard the bear and lynx, and there is a record that a wolf killed sheep near Rossmount in 1942.

In summing up the question of habitat and its influence upon wildlife population on the Ganaraska, H. H. MacKay, Director of Fish Culture, Department of Game and Fisheries, states:

"The character of the population of animals in any place depends on the fitness of the animals for the conditions they have to meet in it. Climate determines the possible range of all species. The distribution of land and water determines possible habitats, but the presence of available food and shelter, competitors and enemies determines the actual habitat.

"The preceding chapter indicates very clearly the effect of the advancement and encroachment of civilization on wildlife habitat. As a result, certain species of desirable fish, birds and mammals were exterminated or their numbers reduced to the vanishing point.

"A progressive and conservation-minded public opinion now supports strict enforcement of protective laws, establishment and development of sanctuaries, control of pollution, floods, erosion, and the development of hatcheries to supplement the work of nature in maintaining good fishing. All these measures are beneficial as efforts to improve existing conditions.

"Nature is wonderfully endowed with recuperative powers, and it is surprising how quickly desirable fish, birds and mammals will increase, if given a proper chance. The objective is not to re-establish original conditions, even if it were possible to do so, but to improve existing conditions for wildlife and at the same time strengthen rather than weaken industrial developments. This is one purpose of the remedial measures recommended in this report. The sure remedy must be based on definite and accurate knowledge, obtained by scientific investigation. If the facts, obtained by the scientific research worker, are used to guide our efforts in improving wildlife habitat, real progress in any comprehensive plan of rehabilitation is assured."

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SURVEYS

"Men are not flattered by being shown that there has been a difference of purpose between the Almighty and them"

CHAPTER NINE

Climate

THE outstanding influence upon the climate in the Ganaraska area is caused by its proximity to Lake Ontario. A very definite moderation, due to the lake influence, is seen in the immediate vicinity of the Lake Ontario shore, while the modification in climate diminishes as one ascends the slopes. On the morainic upland, the climate is definitely colder, exhibiting sharper winters and more backward springs than occur on the rest of the drainage area.

No definite statistics can be given regarding the direction of winds in the watershed, since no local measurements have ever been made. However, averages of wind frequency for Peterborough, Belleville and Toronto, show the frequency for the surrounding region and indicate the general régime. In midsummer, the following percentages have been found for the Dominion Meteorological Station, Toronto: east and northeast winds, about 33%; west and southwest winds, 28% to 30%; north and northwest, about 25%; south and southeast—being the most infrequent—about 10%. In midwinter west and southwest winds contribute nearly 50%, north and northwest less than 25%, east and northeast less than 20%.

High gusts at times do considerable damage to buildings, orchards and woodlots on the Ganaraska, as also do thunderstorms, especially when accompanied by hail. Thunderstorm damage is often extremely restricted in area; sometimes affecting a path not wider than the depth of a concession, or even less.

The amount of sunshine has not been measured in the Ganaraska area but that occurring in Ontario is high in comparison with different parts of western Europe. Bright sunshine for Ontario has been described by Putnam and Chapman[1] as varying from 36% to 45% of that possible while most of the area has from 43% to 45% of the possible amount. The north shore of Lake Ontario, however, (as well as the Niagara fruit belt) has a considerably higher mean than the rest of the province, i.e. 54 to 55 percent. The average annual cloudiness for the province varies from 35 to 65 percent, the greater part of southern Ontario having about 55 percent of sky clouded on the average.

Precipitation in the Ganaraska area shows noticeable local variation. In the lakeshore region, according to record, the mean annual precipi-

[1]The Climate of Southern Ontario, Scientific Agriculture, 1938.

tation varies from 30.0 to 33.5 inches; while, on the slope it varies from 32 to 33 inches with a little less than half falling between April 1 and September 30, and from 7.0 to 9.6 inches in June, July and August. On the other hand, there is greater precipitation on the morainic upland than on the morainic slope and lower regions of the Ganaraska.

Days with measurable precipitation in the Ganaraska area are, in number, near the provincial average. Barrie with 188 such days a year has the greatest precipitation-frequency, while Pelee Island, with less than 75, has the lowest. The western slopes of Grey and Bruce, and Haliburton, have 150 to 170 rainy days, while the Niagara fruit belt and Prince Edward County have from 100 to 125, and Manitoulin 100. On the lakeshore of the Ganaraska, the rainfall for the growing season is slightly more than half the annual total precipitation (15.5 inches to 17.3 inches), while in June, July and August, it totals about 7 to 8.5 inches. The snowfall on the lakeshore averages about 60 inches, with the morainic slope recording the same, while on the morainic upland the snowfall varies from 60 to 76 inches.

In summing up climatic conditions on the Ganaraska, A. J. Connor of the Meteorological Division, Department of Transport, has given the following statement:

"The Ganaraska area is quite small and since the principal meteorological stations are about 100 miles apart, and secondary stations about 25 to 40 miles apart, it has happened that no detailed weather observations have ever been taken within the area. Since in the last century no one in the area has been sufficiently interested to offer himself as observer, we may conclude that the inhabitants have considered the weather of surrounding meteorological stations as sufficiently representative of the Ganaraska area.

"From the data of neighbouring areas, we may say that the most significant feature of the Ganaraska region is its close proximity to the eastern highlands of Ontario. These highlands may be regarded as a southward extension of the Canadian Shield, that great glaciated and largely desolate region which surrounds the Hudson Bay lowlands, includes the upper watershed of the Ottawa River, and crosses near Kingston to join the snowy highlands of eastern New York State. On this great region snow lies fairly steadily all winter and since snow is a very efficient radiator, the ground on the Canadian Shield becomes intensely cold during long, clear, winter nights. In fact, the lowest temperature reached about dawn on clear nights is usually much lower than the temperature which is representative of the lower layers of the airmass which is, at the time, traversing the region. It, therefore, follows that polar or arctic airmasses moving slowly southward from

northern Ontario are not warmed in passing over this region, where temperatures of 20 to 50 degrees below zero are not uncommon in winter.

"These airmasses, therefore, hit the Ganaraska area with scarcely diminished intensity several times during the winter. By contrast, the Niagara fruit belt and much of the Ontario "peninsula" (between the western end of Lake Ontario and Lake Huron) when traversed by the arctic airmass usually finds it materially modified in temperature by prior travel over surfaces which contribute some heating to the lower layers of air.

"On the other hand, airmasses which reach southern Ontario from the Pacific Ocean, the southwestern states, or the Gulf of Mexico, affect the Ganaraska region almost as favourably as any other part of southern Ontario. In spring and fall cold airmasses travelling over the Canadian Shield and affecting easily the eastern highlands may be expected to produce late and early frosts in the Ganaraska area more easily than in southwestern Ontario.

"None of these atmospheric movements produce very strikingly different precipitation in the Ganaraska region, but, of course, the nearness to an efficient source of arctic air favors snowfall accumulation on the higher portion of the watershed. Such an accumulation, when suddenly attacked by a rainfall and sharp thaw, can produce sudden floods on the river.

"To sum up, one may say that although occasional winters may be as mild in the Ganaraska region as in the Niagara region, although occasional growing-seasons may be as long and favorable as in any other part of southern Ontario, yet the proximity to a source of intensely cold arctic air, limits, in the long run, this region to agriculture and horticulture which concerns only rather hardy growth, or comparatively short-season crops. In the long run, such use of the land will minimize losses and eventually pay best, while attempts to grow more tender crops or long-season crops will, sooner or later, result in expensive failures."

CHAPTER TEN

Soils[1]

I. SOIL SURVEYS

The purpose of a soil survey is essentially to establish an inventory of the soil resources. The soils are studied, classified, mapped and described by men who are specially trained in soil science. They are examined in depth as well as on the surface, and such factors as texture, stoniness, colour, structure, organic matter, etc., are noted and examined. The topography and drainage, native vegetation, crops grown and amount of erosion are also noted and correlated.

It will be seen from the above that soils data is basic to any present or proposed land use problem. The information in the Durham Report, and the special soil map accompanying this report, indicate at once the broad tract of marginal and submarginal land, approximately 20,000 acres in size, at the extreme north of the watershed, which is recommended elsewhere for combined forestry and agricultural purposes.

The main unit in the classification of soils is the "series" which includes soils with essentially the same profile. (Cross-section of soil from the surface down to the geological material from which the soil is formed). Each series is given a name, usually the name of the township or place near which that series was first mapped. There may be two or more "types" within each series, depending on minor variations in texture. Thus we have a Brighton sand and a Brighton sandy loam.

The main descriptions of the soils are on the basis of series and include the following:

1. Occurrence and distribution.
2. Profile and description.

A_1 Horizon—refers to the dark coloured mineral soil commonly called the surface soil.

A_2 Horizon—refers to the lighter coloured leached layer immediately below the surface soil.

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[1]Excerpts from two unpublished reports, The Soils of Northumberland County and The Soils of Durham County, co-operative soil survey projects by the Experimental Farms Service, Dominion Department of Agriculture, in co-operation with the Ontario Agricultural College, Guelph, Ontario. The field work was done in Northumberland by G. A. Hills and N. R. Richards, in Durham by L. R. Webber and C. A. Nichol, and was supervised by F. F. Morwick.

B Horizon—refers to the brownish, more compact layer.

C Horizon—refers to the unweathered or only slightly weathered geological material.

3. Topography and Drainage.

Slope is expressed in percent, a rise of 10 feet in a distance of 100 feet being a slope of 10 percent. Slopes are designated by letters and are also described by topographical terms. The recognized classification of slope is as follows:

Slope Group	Percent Slope	Topographical Terms
A	0– 3%	level to nearly level
B	3– 8%	undulating
C	8–15%	rolling
D	15–25%	hilly
E	25–35%	very hilly
F	35% and over	steep

4. Natural vegetation (mainly the dominant native trees).

5. Types mapped within the series.

6. Agriculture.

2. THE SOILS OF THE GANARASKA WATERSHED

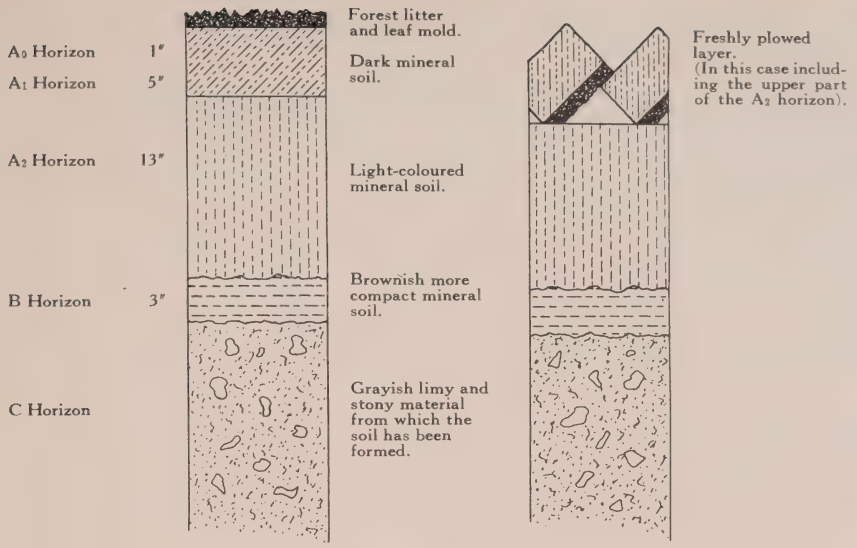
These soils are within the grey-brown Podsolic group of soils but are less acid than most of the soils within that group. They are developed on high lime materials and the cultivated soils are usually near neutral to alkaline in reaction. A profile of the Bondhead fine sandy loam, which is typical of the well-drained soils of this region is shown on page 107. In many rolling cultivated fields the upper part of the soil has been washed or blown away and the lower horizons of the natural soil are exposed at the surface.

[a] Description of Soils:

The soil series are arranged in five groups (A to E), on the basis of the geological materials from which they are formed.

A—SOILS FORMED FROM LIMESTONE TILL

The materials from which this group of soils is formed comprise a mixture of Trenton and Black River limestones with small proportions of Precambrian materials. These materials have been deposited as a



Bondhead fine sandy loam, generalized soil profile typical of the soils of this region, showing how comparisons may be made between virgin and cultivated soils and also how much erosion has taken place.

compact, unassorted mass with particle sizes varying from fine clay to boulders. There appear to be more Precambrian boulders or "hard heads" in the Otonabee soils than in other types. There is sufficient porosity to permit good internal drainage, excepting depressed or seepage areas.

Bondhead Series

The Bondhead soils represent the largest acreage of any series mapped in Durham County. The several types are well distributed throughout the entire area.

The following is a profile description of a cultivated soil:

A_1 4-6 inches of a grey brown loam or fine sandy loam; friable crumby structure; few stones; moderately alkaline.

A_2 8-12 inches of a greyish brown sandy loam or loam; open and coarse structure.

B 2-4 inches of a brownish loam.

C A grey calcareous till dominated by limestone materials and containing some fragments from Precambrian rocks; frequent stones and boulders.

The topography of the Bondhead Series is characterized by drumlins or elongated hump-backed hills. Long and gentle slopes form a part of each drumlin but on the sides and near the top, steeper slopes are common. The topography is considered rolling with slopes in the B, C and D classes. The drainage is good. The natural vegetation includes sugar maple, beech, basswood, some elm and ash. The areas of lighter soils support appreciable amounts of white pine.

1. Bondhead loam is located in scattered locations south of the height of land.

2. Bondhead fine sandy loam constitutes some of the better agricultural soils of the watershed.

3. Bondhead fine sandy loam (bouldery phase): The areas mapped as a bouldery phase are recognized by the numerous boulders and stones on the surface soil. The stoniness is a limiting factor in the agricultural development of the type. Generally this type is left in pasture.

The Bondhead types (except the bouldery phase) are good soils for general agriculture, which includes grain growing, raising livestock, and areas for pasturage. The greater part of the series is used for general farming, and dairying is featured on some areas. Over most of the area an increased acreage of alfalfa would assist in maintaining the fertility and provide excellent hay or pasture. Where commercial fertilizers are used, phosphorus and potassium are particularly recommended. The steeper slopes of the drumlins should be left in hay, pasture or bush as long as possible. Methods that retard soil erosion must be considered and used on the Bondhead types.

Otonabee Series

The Otonabee loam is found in small areas throughout the watershed.

The following is a profile description of a cultivated soil of this series:

A_1 4-6 inches of a dark grey brown loam; a good friable structure; moderately stony; free carbonates.

A_2 0-4 inches of a greyish brown loam; more open and incoherent than A_1.

B 0-3 inches of a brownish loam or clay loam; somewhat sticky; weak nut-like structure.

C A grey calcareous till containing fragments of Precambrian rocks; compact; frequent stones and boulders.

4. Otonabee loam: The Otonabee loam has been separated from the Bondhead series on the basis of a shallower profile that developed from

similar parent materials. The greyish parent material frequently appears on the surface of ploughed fields.

The topography of the Otonabee loam is recognized by numerous well-formed drumlins. In some instances the topography approaches the hilly condition where steep slopes are more common. The drainage, internal and external, is good but considerable run-off of the rainfall occurs.

The hardwoods, sugar maple and beech are the common trees. White pine, elm and ash occur less prominently.

5. Otonabee loam (steep phase): This type includes any very steep till soil that should be left in permanent pasture or bush. Generally, the slopes are above 30 per cent.

6. Otonabee sandy loam: The only area of this soil within the watershed occurs in Hamilton township. It has a slightly deeper profile than the loam.

The agriculture differs very little from the general type of farming on the Bondhead series. Cereal grains, hay, clover, ensilage corn and pasture represent the important crops grown. Livestock raising and some dairy farming provide a large portion of the sources of farm income. The high lime soil is well adapted to growing alfalfa and clovers. Balanced fertilizers used on this type generally contain a high percentage of phosphorus and potassium. There are some general soil conserving practices that could be applied to the Otonabee loam: pasturing or using the steep slopes as hay fields, cultivating and ploughing "around the hill" rather than up and down the slope, and using a longer rotation.

Dundonald Series

7. Dundonald sandy loam is the only member of the series mapped on the watershed.

The following is a profile description of a non-eroded cultivated soil:

A_1 4-6 inches of a grey brown sandy loam approaching a single grain structure; generally a low organic matter content; near neutral in reaction; stonefree.

A_2 10-15 inches of a light brownish, coarse, open structureless sand.

B 2-3 inches of a brownish loam.

C Grey calcareous till; frequent stones and boulders; in some areas the till is very compact.

The Dundonald profile is generally developed in the sandy materials that are underlain by a limestone till. The B horizon normally occurs at the juncture of the sandy outwash deposit and the till.

Drumlin formation is less distinct but B, C, and D slopes are general. The topography is strongly rolling. The drainage is good; the lighter materials tend to permit an excessive rate of percolation.

Coniferous and hardwood trees are about equally distributed over the type. A shallow eroded profile and proximity to the till are often associated with the presence of hardwoods.

The agriculture is general in nature. Special practices are used in some localities to increase the organic content of the surface soil by ploughing down green manuring crops.

Generally, apple growing has not proven highly successful largely because of the erodible nature of the soil and climatic factors. Erosion is common where the soil is cultivated up and down the slope and when the surface is left unprotected for long periods of time.

Lyons Series

8. Lyons loam is the only member of this series.

The profile shows very little differentiation into horizons; the A_1 is a stony calcareous loam underlain by a shallow mottled layer grading into the limestone till.

The topography in most areas is nearly level or may be sloping equivalent to the well-drained associated till soil. Lyons loam often indicates a seepage area or the source of a spring.

White cedar is the principal tree growth.

The stony and bouldery nature of the type and the poor drainage conditions limit the type to a land use that is largely permanent unimproved pasture.

B—SOILS FORMED FROM FLUVIO-GLACIAL MATERIALS

The fluvio-glacial materials occupy a position roughly corresponding to the location of a great ice crevice that formed during the time of the melting-back of the glacier. Through this crevice a great volume of meltwater found an outlet and deposited the materials from which the present soils were formed. The materials are predominantly sand, gravel and boulders; isolated till deposits occur but are of a minor concern. The nature, mode of deposition and coarseness of these materials, together with the hilly relief, provide circumstances that limit the agricultural use of these soils.

Pontypool Series

The series occupies a large tract of land extending east and west across the northern section of the watershed. As a series it is fairly well centralized and does not occur in small isolated areas as do other soil types.

The profile is almost featureless but examinations of non-eroded sites indicate extensive weathering.

A_1 2-3 inches of light grey brown sand or sandy loam; coarse single grain structure; low in organic matter; slightly acid to slightly alkaline; frequently stony.

A_2 10-30 inches of yellowish sand; in the sandy loam profile an incipient B horizon generally exists but it is usually absent in the sand.

C A grey coarse calcareous sand; limestone in origin; numerous cobbles and gravelly stones.

The topography is hilly with frequent steep slopes and small depressional areas, known as a "knob and kettle" relief. Generally, the sandy loam type is strongly rolling with slopes that are longer and less abrupt. The topography varies from small areas of undulating deposits to areas that are very hilly, with a common slope range from 8 to 35 per cent. In view of the coarse nature of surface and parent materials, low organic matter content of the topsoil and the hilly terrain, the drainage is rapid and excessive.

The vegetative growth normally depends on the soil type within the Pontypool series. The sand is most favourable to growing white pine, with smaller proportions of red, jack and Scotch pine and hardwoods. The natural grasses on abandoned farms are usually redtop and Kentucky blue. The gravelly type is broadly associated with sugar maple, red oak, beech, hickory and white pine; Canada blue grass is common on this type.

9. Pontypool sandy loam: A small percentage of the series is mapped as sandy loam. On these areas a type of general farming is fairly successful. Future agricultural policies may discourage agriculture on most of the series, but if careful and conservative methods are employed, the Pontypool sandy loam may support a type of part-time farming.

10. Pontypool sand: Erosion is severe and the natural fertility is low. More than one-half of the series is mapped as a sand with the variation to be expected from such rough topography. The type represents a poor soil for agricultural purposes.

Panorama of the Ganaraska Watershed looking south and east from Tower Hill, elevation some of the area occupied

11. Pontypool gravelly sand: The gravelly sand differs from the above type by having large deposits of gravel in the parent material. In many areas the gravel appears in the surface soil. Near Pontypool farming is more successful than on the sand.

Undoubtedly, a large portion of the series is not adapted to general farming. Some areas now under cultivation should be retired from agriculture. There are other land uses for which the series is suitable: large permanent and improved pastures, reforestation, game preserves, and recreation. Pontypool sandy loam offers the best in the series for farming but, even then, conservation farming and heavy applications of manure and fertilizers, and ploughed-in green crops, are necessary to maintain adequate fertility levels.

C—SOILS FORMED FROM DELTAIC OR OUTWASH MATERIALS

The parent material of this group of soils was carried by streams of water. The materials were dropped as the stream slowed up or emptied into large bodies of still water. These outwash materials are coarse sand and gravels of limestone origin.

Brighton Series

This series occurs largely within the area once covered by Lake

1,285 feet above sea level (1,032 feet approximately above Lake Ontario), and showing by the Pontypool soils.

Iroquois, or that part of the watershed lying below the old C.N.R. right-of-way.

The profile development bears out the relative youthfulness of soils within the Iroquois basin.

A_1 3-4 inches of sand or sandy loam; low in organic matter; near neutral in reaction; stonefree.

A_2 15-20 inches of a coarse yellowish sand; single grain structure.

B 0-2 inches of brownish loam; rarely present in sand type but general in the sandy loam.

C A grey calcareous stratified sand or sand and gravel.

While the Brighton series were undoubtedly deposited in nearly level relief, stream gullying and erosion have effected noticeable changes in the topography. Except for isolated areas and near stream courses, most of the series is within the B slope class, 3-8 per cent. The drainage conditions are good; the coarse materials promote rapid and perhaps excessive removal of soil water.

The dominant vegetation is white pine, especially in the Osaca district.

12. Brighton sandy loam: The sandy loam type is more suitable for general farming than the remainder of the series. The slightly heavier texture and better fertility are the principal differences.

13. Brighton sand: The coarse sand is low in fertility, excessively drained, subject to severe erosion and not adapted to general agriculture. A small acreage is producing tobacco.

14. Brighton gravelly sand: This type exhibits a very shallow profile over the calcareous stratified gravel. Most of the type indicates the location and extent of the beaches of Lake Iroquois. The deposits are usually long rounded ridges of gravel or appear as broad fans.

15. Brighton sandy loam (bouldery phase) is mapped to indicate extremely stony light textured soils that are well drained. The total acreage is small.

Very little of this series occurring on the watershed, except the sandy loam, is adapted to general agriculture. Heavy applications of manure and fertilizers are necessary to produce farm crops satisfactorily. The organic matter content of the surface soil must be increased to prevent excessive drainage and leaching of plant nutrients. Tobacco appears to thrive on the sand, providing the profile is about 30 inches deep and not eroded. A few orchards are in good condition, but the success is largely due to excellent management. The gravelly sand supports good stands of grass, particularly Canada blue, in seasons which are not too droughty.

Tecumseth Series

16. Tecumseth sandy loam is mapped as the imperfectly drained associate of the Brighton series.

The profile is typical of imperfect drainage conditions. The A_1 horizon is a dark sandy loam, 5-7 inches in depth, above average in organic matter and neutral to alkaline in reaction. The A_2 horizon is recognized by a highly mottled condition grading into the parent material. The C horizon is composed of the outwash materials, grey calcareous stonefree sand.

The Tecumseth is found in depressions or broader areas of level relief and frequently hemmed in by morainic soils. Drainage outlets are inadequate; artificial methods are not generally recommended.

Tamarack and white cedar are the chief tree growths and a large variety of grasses common to soils with a high water table.

Small local areas of better drainage are cultivated and sown to spring grains, but a large acreage is in pasture. Certain crops like buckwheat are adapted to the type.

Granby Series

This series is the poorly drained component of the outwash soils. The profile is poorly developed; the A_1 is a deep layer of mineral soil, high in organic matter, normally alkaline and stonefree. The A_2 is a shallow horizon of greyish coarse sand, having some degree of mottling, dependent upon local drainage conditions. The parent material is a grey coarse calcareous sand.

The Granby is found in depressional areas with level topography. The natural drainage is poor; the cost seldom warrants artificial drainage.

The series supports a swampy vegetation of trees, shrubs and grasses. After the wood is cleared off, some species of grasses suitable for pasture can be sown.

17. Granby sandy loam is the only type mapped in this series.

General agriculture is practically prohibitive; permanent pasture is the principal land use.

D—SOILS DEVELOPED FROM LACUSTRINE MATERIALS

During the recession of the ice lobes, bodies of water were hemmed in by ice masses or by deposits of glacial drift. These glacial lakes were fed by streams of meltwater that carried finely divided soil-forming materials. The characteristics of these lacustrine deposits are: intermediate or heavy texture, stonefree and level to undulating topography. The finer materials carried by the water remained in suspension longer than the coarser aggregates. It is generally believed that the coarser separates settled out in the summer season, while the finer portions dropped out during the winter while the water was motionless. This layering of parent soil materials according to seasons is referred to as varving. Varves are characteristic of lacustrine or water-laid materials.

Newcastle Series

The Newcastle series is also found within the area covered by glacial Lake Iroquois. This plain extended over a portion of the two southern townships; the beaches of the lake marked by Brighton gravelly sand are about 450 feet above sea-level, or about 200 feet above Lake Ontario.

The following is the profile description of a cultivated soil:

A_1 4-7 inches of a moderately dark grey brown loam or clay loam; small nutty structure; friable under optimum conditions; stonefree; neutral in reaction.

A_2 8-15 inches of a greyish brown loam; crumby structure; lower limits approach a B_1 condition.

B 4-10 inches of brownish sticky clay; when dry breaks into a blocky structure.

C Greyish calcareous stonefree lacustrine silts and clays; very compact and frequently varved.

The areas of Newcastle loam and clay loam are considered to be undulating in topography, marked by gentle slopes within the B class. In some instances steeper slopes are found that are the result of recent stream erosion; bluffs are common along the lake shore, providing excellent locations for examination of varves. There are some areas where the drainage is only fair; water accumulates between the swells of land after heavy rains and in the spring. Generally the drainage is fair to good.

Woodlots are scarce but those remaining are composed of sugar maple and beech; elm is frequently found in the areas with only fair drainage.

18. Newcastle loam is generally considered the better orchard soil because of the adequate drainage, fewer low areas, and a more friable nature, allowing deeper root penetration. The natural fertility is above average, excepting the supply of available phosphorus.

19. Newcastle clay loam: The heavier type in the series is a productive soil for general farm crops. The soil generally has the highest natural fertility of any type in the county but, like all others, requires phosphatic supplements. The areas of fair drainage are more common in the clay loam type.

Orchards are confined largely to the loam type since it has better drainage and less compaction of subsoil and parent material. The series supports excellent farms of general agriculture and dairying. Large acreages are devoted to a rotation, including grain, corn, roots, pasture, clover and hay. Some caution should be exercised in preventing sheet erosion on the smooth slopes. Inter-tilled crops such as corn, roots and potatoes, encourage the removal of the topsoil by washing. Destructive erosion is prevalent along stream courses and at the lake-shore.

Schomberg Series

Several small areas of this series are found east of Canton. The profile of this series is relatively shallow and frequently eroded.

A_1 4-6 inches of a moderately dark grey brown silt loam or clay loam; a greyish surface indicates severe sheet erosion; friable structure; nearly stonefree; free carbonates.

Over one-half of the land area of the Ganaraska Watershed is classed as crop land, much of which is of excellent quality—A snug farmstead on the 7th Concession of Clarke. Soil in the foreground is Brighton sand; in the background Otonabee loam, steep phase.

A_2 6-10 inches of greyish leached horizon, sharp demarcation.

B 3-6 inches of a brownish sticky clay.

C Dull grey or greyish silts and clays; lacustrine origin; highly calcareous; occasionally varved; till may occur if the lacustrine veneer is shallow.

The dominant slopes within the Schomberg series are in B class. The internal drainage is good; the running-off of excessive surface water frequently causes sheet erosion.

Hardwoods, including maple, beech and ash, are the common trees associated with the series; elms are minor.

20. Schomberg clay loam is developed on a lacustrine veneer underlain by till. The crops on smoother areas may suffer seasonal damage by the inadequate removal of excessive surface water.

The undulating slopes of a lacustrine soil are very susceptible to sheet erosion, unless particular management is employed. Such soils respond to long rotations, with a minimum of cultivated crops that can be worked into most types of farming. The Schomberg series is a high lime soil admirably suited to clovers and alfalfa. Commercial fertilizers

should contain relatively high percentages of phosphorus and potassium. The use of improved permanent pastures on slopes now showing the effects of erosion is strongly recommended. Areas likely to erode badly should be dealt with according to soil conserving plans.

Percy Series

This series is generally considered to be a lacustrine soil. Fine sand and loam over heavier materials is the common condition as mapped.

21. Percy loam: The surface layer is a grey brown loam or fine sandy loam,neutral or slightly alkaline in reaction and stone free. The texture and structure give a friable and tilthy soil. The A_2 is a greyish layer frequently mottled near the B horizon. The B horizon is shallow but sharply marked. The underlying materials are fine sands and silts with high percentages of clay.

22. Percy fine sandy loam: The only area occurs in Hamilton township.

The topography is strongly undulating. The drainage conditions are satisfactory and adequate.

If the severe sheet erosion were controlled, this would be an exceptionally valuable soil, but much of the topsoil has been lost.

Smithfield Series

23. Smithfield clay loam represents the imperfectly drained associate of the lacustrine soils. The existing areas occupy small depressions lacking adequate drainage facilities. Some areas are in regular crop rotations where the surface water is removed by ditches.

The profile is characteristically featureless, indicating the restricted drainage; the surface soil is a dark and deep clay loam or silt loam underlain by a highly mottled silty clay. The parent material is a drab grey calcareous clay.

The acreage of Smithfield clay loam is about equally divided between permanent pasture and regular farm crops. The drainage is the limiting factor for greater agricultural use.

E—MISCELLANEOUS SOILS

24. Bridgman sand: This type of soil may be found in areas of Pontypool and Brighton where the surface layer has been entirely removed by wind and water erosion. The usual condition is to find the soil drifting. Bridgman sand includes the areas devoid of a normal surface layer and areas where the wind borne materials have accumulated.

The remaining soil is a coarse open incoherent droughty sand on which it is very difficult to restore vegetation. The type is a definite degrading factor for adjacent agricultural soils.

It is strongly recommended that this type be treated separately from adjoining pasture or crop land and be reforested.

25. Bottom land should be considered as a complex condition located in or near the channels and courses of streams. In such positions, bottom land is subject to flooding and surface depositions of materials carried by the water. Under these conditions a variety of soil materials is to be expected.

The type provides an excellent arrangement for pasturing since water is usually close at hand. However, the pastures are rarely improved and too often are viewed as waste land. There is very little further agricultural development of the type beyond grazing.

26. Muck: Practically none of the muck has been developed for general or special agriculture. Most deposits are depressional and in-

Gully erosion on the Pontypool sand.

Photograph by N. R. Richards.

capable of being adequately drained for a reasonable expenditure. Generally the areas are heavily vegetated.

[b] Soil Groups:

The accompanying soil map shows the distribution of soil types over the watershed. The soil types are grouped on the basis of their suitability for the general farm crops such as are usually grown on any mixed farm in this region. Some of these same soils may have an increased value for certain specialized crops such as tobacco. (These groupings have reference to the type as a whole and not in detail in each area as mapped.)

Group I

This group includes a wide variety of soils, which in many instances constitute problem areas. They may be considered at least suitable for general agriculture. They are listed below with their main limitations and recommended uses.

No.	Symbol	Name	Acres	Limitations and Recommended Uses
5	Ol-s	Otonabee steep phase	2,450	Steepness—Permanent pasture or forest.
11	Pg	Pontypool gravelly sand	2,710	Low fertility and steepness—Generally reforestation excepting in local areas.
10	P-s	Pontypool sand	11,522	Low fertility and steepness—Generally reforestation, with very few exceptions.
25	B.L.	Bottom land	4,060	Subject to flooding—Permanent pasture and some general farming.
3	Bb	Bondhead bouldery	180	Extreme stoniness—Pasture and general farming if stones are removed.
8	Ll	Lyons loam	40	Stoniness and imperfect drainage—Permanent pasture.
15	Br-b	Brighton bouldery	100	Stoniness and low fertility.
26	M	Muck	620	Largely wooded and very poor drainage—Water reservoir.
24	B	Bridgman sand	580	Drifting—Reforestation.
		Total acres	22,262	

Group II

These soils are more suitable for general farming than those in Group I. However, their proper management involves practices which are rather costly in proportion to the returns received. In some instances, they can be used to better advantage for some specialized crop. They are listed below with their main limitations.

No.	Symbol	Name	Acres	Limitations
17	Gsl	Granby sandy loam....	1,080	Poor drainage.
9	Psl	Pontypool sandy loam.	1,420	Light textured, steeper slopes, and susceptibility to eroson.
13	Bs	Brighton sand.....	6,430	Low fertility and erodibility.
14	Bg	Brighton gravelly sand.	920	Low fertility and gravelly nature.
		Total acres.....	9,850	

Group III

These soils are usually quite suitable for general farming but have some limiting features. On many farms these limiting features have been taken care of and the farms are producing good crops.

No.	Symbol	Name	Acres	Limiting Features
23	Scl	Smithfield clay loam...	560	Imperfect drainage.
12	Brs	Brighton sandy loam...	3,700	Light textured soil of moderate fertility.
16	Tsl	Tecumseth sandy loam.	1,010	Imperfect drainage.
7	Dsl	Dundonald sandy loam.	9,260	Susceptibility to erosion.
		Total acres.....	14,530	

Group IV

This group may be considered as the most suitable for general farming. While they also have undesirable features in some instances, they have in general the best inherent capacity to produce good field crops.

No.	Symbol	Name	Acres
20	Shcl	Schomberg clay loam....	670
19	Ncl	Newcastle clay loam.....	320
18	Nl	Newcastle loam.....	2,140
21	Pl	Percy loam.....	250
22	Pfs	Percy fine sandy loam...	880
1	Bl	Bondhead loam.....	5,100
2	Bsl	Bondhead fine sandy loam	9,129
4	Ol	Otonabee loam.....	400
6	Osl	Otonabee sandy loam....	380
		Total acres.....	19,269
		Grand total.....	65,911

CHAPTER ELEVEN

Soil Erosion and Land Use[1]

SOIL erosion on farm land in some parts of Ontario has reached serious proportions. Nowhere, perhaps, is this better exemplified than on certain sections of the Ganaraska area. It is of special significance, therefore, that a part of Hope Township should have been selected as the location of the first study of this kind to be carried out in Eastern Canada.

The problem of soil erosion control is so vitally connected with the ultimate purpose of the Ganaraska Survey, that such a study as the one referred to above is of paramount importance, and because of this is included, in an abbreviated form, in the present report. Certain sections of it, which are covered elsewhere in the main report, have been deleted, as well as several tables which it was felt would not lessen to any serious degree the presentation of the main problem and the recommendations offered for its solution.

1. DESCRIPTION OF THE AREA

[a] Location:

The project area consists of approximately 22,080 acres of the north-west corner of Hope Township, and is bounded more precisely by the Township of Clarke on the west, the Township of Cavan on the north, the county highway, or Millbrook Highway, on the east, and the Fifth Concession road of Hope Township on the south.[2]

[b] Soil History:

Under natural conditions the soil in Hope Township supported a protective cover which allowed the topsoil to develop more quickly than normal erosion could carry away. After the protective cover was removed and the area subjected to cultivation, erosion in its various forms began to gnaw at the steep hillsides and rolling fields. The loss of the fertile topsoil has not been commonly recognized as a serious menace to the agricultural permanency and prosperity of the area. This may be

[1] An abridgment of the Report, "Soil Erosion and Land Use Survey of Hope Township Project Area, Durham County, Ontario," by N. R. Richards and F. F. Morwick, a Co-Operative Soil Survey Project by the Experimental Farms Service, Dominion Department of Agriculture, in Co-Operation with the Ontario Agricultural College, Guelph, Ontario.

[2] See map accompanying this report and map accompanying unabridged report referred to in above note.

due, primarily, to the process by which erosion slowly but relentlessly steals the wealth from our farm lands. So slow may the erosive forces act that it is difficult to detect the gradual removal, but over a long period this loss reaches alarming proportions. Gullies, the most easily recognized of erosive activity, are much in evidence and interfere with cultivation, even though but a few feet in depth. Unless attention is directed to the control of growing gullies, portions of fields become abandoned for agricultural purposes. Further, areas that once supported valuable stands of oak, maple and beech now lie idle, mute testimony of the ravages of wind erosion. After the sandy hills were cleared of the natural cover, their fertility was rapidly depleted under continuous cropping. Low unprofitable yields eventually resulted in farmers using this land for pasture. Insufficiently fertile to produce an adequate vegetative cover to hold the surface soil it began to succumb to the destructive action of wind erosion. "Blow sand" areas of various proportions now spot sections of Hope Township.

[c] Topography:

The area is characterized by steep hills in the northern section. In the central section the topography is strongly rolling with the exception of Dean Hill which rises 175 feet above the surrounding country. Smoother topography dominates in the southeastern portion of the area; in the Crooked Creek area of Concession V the topography is level to depressional.

The elevation varies from 400 feet in Concession V, the southern boundary, to 1,100 feet in Concession X, a rise of 700 feet in approximately 7 miles.

[d] Drainage:

The Ganaraska and North Ganaraska Rivers are the principal drainage units of the area. Springs located in the sand hills of the northern section of the project area and adjoining areas feed these streams. Flowing through the rougher topography they have entrenched themselves in deep channels. As they reach the southern section of the area they wind their way through an old flood plain which is 75 to 100 feet below the adjoining uplands. The two branches join in Concession IV just south and east of the project area and enter Lake Ontario at the town of Port Hope. In high water seasons the rivers overflow their banks, depositing alluvial soil and debris on the areas of smoother topography. Both the Ganaraska and North Ganaraska flow throughout the summer.

Tributaries of these streams dissect the area and with the exception of the southwestern portion provide adequate regional drainage. How-

ever, small poorly drained depressional areas may be found over the whole region. Crooked Creek, a slow sluggish stream, located in the southwestern section has its source in the poorly drained sands and muck soils. This section contains the largest portion of poorly drained soils in the area.

[e] Climate:

Climate has a very important bearing on the agriculture of the area in so far as it influences plant distribution, crop production, and erosional processes. Precipitation, evaporation, temperature and wind are the most important climatic factors to be considered. Although the climatic variations within the project area are not sufficiently great to affect the soil profile development, the climatic factors have a very important bearing on the amount and intensity of erosion the area is subjected to.

[f] Vegetation:

The type of natural vegetation which becomes established in any area depends largely on climatic conditions and on the physical, chemical and geological characteristics of the soil. The nature of the vegetation has an important bearing on the type of weathering that takes place in the soil and it is, therefore, very desirable that close attention should be paid to the natural vegetation in soil studies.

Since most of the original forest cover in the area has been cut down, it is difficult to determine the original relationship between vegetation and the soil. On the hilly droughty sands of the north, white and red pine, red oak, and sumach are commonly found. While few pines remain to-day, it can be easily seen from the stump fences that originally the soil supported a pine vegetation. "Oak Hill" in Concession IX supported in the early days, as the name indicates, a valuable stand of oak.

The limestone till soils in the surveyed area support a growth of mixed hardwoods and conifers; white pine, sugar maple, beech, ironwood, basswood and hemlock are found in varying proportions. Along the stream courses white cedar is the dominant tree species found.

In the well drained outwash sand, red oak, sugar maple, spruce, white pine and choke cherry form the common species. The very poorly drained areas have sedges, cattails, and flags. Many other poorly drained areas are characterized by white cedar, box alders and willows.

[g] Agriculture:

Mixed farming is the dominant type of agriculture being practised over most of the area at the present time. Small grains and hay are

grown to feed livestock. Production of butterfat, beef cattle, swine and poultry form the basis from which the farm income is derived. Just as the chemical, physical and biological characteristics of a soil are reflected in the natural vegetative cover, so too are they reflected in the crops the soils support under present land use. Rye is found growing on the rough hilly sands of the north and the deep well drained sandy soils of the central area. Because of the low natural fertility and droughty nature of the soil, the yields are low. Few farmers use alfalfa in their grass seed mixture because of the high cost of the seed and the financial risk involved in not getting a catch owing to the limiting physical characteristics of the soil. Fertilizers are rarely used.

Oats, wheat, barley and hay are the most common farm crops grown on the limestone till soils (Bondhead fine sandy loam and Dundonald sandy loam). The more productive farms in the project area are located on these soils. Many farmers have developed a short 3 or 4 year rotation in which a red clover and timothy grass seed mixture is used and only a small percentage use alfalfa in the grass seed mixture. Because of their rough topography, the till soils are very susceptible to sheet erosion. As a protective erosion measure, the length of rotation should be increased through the simple practice of including alfalfa in the grass seed mixture. The success and satisfaction of the farmers who use alfalfa in their rotation at the present time should be a strong recommendation for its more general use.

Fertilizers are not commonly used on the till soils. Manure from the livestock fed on the farm is returned to the soil and is the only attempt made to maintain an adequate fertility level.

The growing of buckwheat is confined to the more poorly drained sandy soils. The impeded internal drainage of these soils limits the variety of crops that can be produced on them. Usually it is late in the spring before they are in a suitable condition to be cultivated.

Tobacco has been grown successfully on the well drained outwash sandy soils in the southern part of the area for 3 or 4 years. The cultural practices necessary for the successful growing of tobacco make it better adapted to these soils than crops ordinarily grown for a livestock system of farming. More of the sandy soils will be used for tobacco growing if climatic factors prove to be satisfactory.

Apples are grown with considerable success where the orchards are located on suitable soil types. Small acreages of canning crops and beans were recorded during the survey. For the successful production of these crops special cultural and fertility practices are required.

2. MAPS AND METHODS

The base map used for this survey was the Military Topographic Map, raised to the scale of four inches to the mile, and all data were recorded in such detail as the map would permit. Aerial photographs taken by the Dominion Government in 1927 were used for checking data on the ground.

The type of soil, slope, kind and degree of erosion, were mapped in relation to present land use. Fourteen soil separations, as shown in the Durham County Soil Survey,[1] were recognized. No new types were mapped but the soil boundaries were adjusted to include more detail, made possible by the larger scale maps and more detailed traverses.

Slope was mapped by the use of the Abney Level. Five slope groups were recognized. These groups express the variations in the slope factor as they affect soil erosion. "A" (0-3 per cent) slopes are nearly level areas on which there is very little sheet erosion regardless of the cover or use. "B" (3-8 per cent) slopes are those that are subject to erosion if they are not protected by an adequate vegetative cover. "C" (8-15 per cent) slopes require more intensive control and corrective measures if they are cultivated. "D" (15-25 per cent) and "E" (25-35 per cent) slopes are too steep for cultivation and should be maintained in permanent cover. "F" slopes are those 35 per cent and over.

3. SOILS

Soils of the area are described in detail in the chapter on soils. The acreage and percentage of each soil group and type occurring in the area under consideration are indicated in Table 1.

4. SLOPE

Slope affects the rate of run-off of water falling on the land, and thus the susceptibility of any area to erosion. Slope classes afford an expression of this factor as it affects the capability of the land for agricultural use, but other factors such as stoniness, poor drainage or advanced erosion may limit the use of gentle slopes.

"A" slopes include relatively flat areas on which there is very little if any sheet erosion under ordinary systems of cropping and tillage. Of the soils mapped in the area, 6,176 acres, or 27.9%, are included in this class, which is composed largely of the outwash sandy soils. The "A" slopes of the till soils are the most valuable agricultural areas, providing the drainage is adequate and excessive stoniness does not interfere with cultivation. With the use of good farm practices the "A" slopes of the

[1] "The Soils of Durham County," by L. R. Webber and F. F. Morwick. (Unpublished).

TABLE 1

Soil Group and Type	Area	
	Acres	Percent.
Limestone till soils	**7,480**	**33.9**
Bondhead fine sandy loam	4,010	18.2
Dundonald sandy loam	3,470	15.7
Fluvio-glacial soils	**4,190**	**19.0**
Pontypool sand	3,430	15.5
Pontypool sandy loam	720	3.3
Pontypool gravelly sand	40	.2
Well drained outwash sandy soils	**5,750**	**26.0**
Brighton sand	3,610	16.4
Brighton gravelly sand	260	1.1
Brighton sandy loam	1,880	8.5
Imperfectly drained outwash sandy soils	**2,430**	**11.0**
Tecumseth sand	780	3.6
Tecumseth sandy loam	100	.4
Granby sandy loam	1,550	7.0
Miscellaneous soils	**2,230**	**10.1**
Bridgman sand	480	3.2
Bottom land	950	4.3
Muck	800	2.6

Pontypool series can be successfully farmed. Suitable physical characteristics and level topography of the Brighton series meet the necessary requirements for specialized tobacco growing on these soils. In some areas considerable alluvial deposition has occurred on the "A" slopes of the till soils, and particularly along stream courses.

"B" slopes were mapped on 5,038 acres, or 22.8%, of the area. This slope class is composed largely of the till soils. With the use of good agricultural practices and well adapted crop rotations, these soils do not present a serious erosion problem. On the "B" slopes of the sandy soils gully erosion in varying intensity is frequently found.

"C" slopes occupy 5,544 acres, or 25.1%, of the area. Over 40% of the till soils and the Pontypool series are contained in this series. Many of these slopes have been moderately or severely eroded and require careful erosion control practices for use as cropland.

"D" slopes occupy 2,436 acres, or 11% of the area. Much of the sandy Pontypool and Brighton soils along the stream courses are included with this slope class. These slopes are too steep for continuous cultivation and serve their greatest use if kept under permanent cover. Observation has shown that the soils contained in the "D" slope class are liable to serious soil washing unless they are kept almost continuously

in good grass cover or returned to woodland. For a woodland cover to be most effective in preventing soil erosion, the surface litter of leaves and the brushy under-cover should not be destroyed by grazing.

"E" and "F" slopes normally are too steep for cultivation or pasturing and should be left in woods or reforested, both for their own protection and that of the lower lying level land. "E" and "F" slopes occur on 1,456 acres, or 6.8% of the area.

5. PRESENT LAND USE

Four divisions namely cropland, pasture land, woodland and idle land were separated. Cropland includes all land planted to crops, fallow land, orchards and areas seeded down and crops grown in rotation for hay or pasture. Farmsteads, although separated during the progress of the survey and occupying 1.5% of the total area, are included with cropland for purposes of discussion. Areas used for grazing and not included in the regular system of crop rotation, were mapped as permanent pasture. Open land showing neither of the above uses was considered idle land. Land with 40% or more of its area covered with trees was mapped as woodland.

TABLE 2. Land Use According to Soil Type

Soil Type	Cropland		Pasture Land		Woodland		Idle Land	
	acres	%	acres	%	acres	%	acres	%
1. Bondhead fine sandy loam	2,892	72.2	932	23.2	132	3.4	54	1.2
2. Dundonald sandy loam	2,240	64.6	928	26.7	180	5.2	122	3.5
3. Pontypool sand	812	23.7	1,460	42.6	976	28.5	182	5.2
4. Pontypool sandy loam	260	36.0	396	55.0	64	9.0	.....	.....
5. Pontypool gravelly sand	40	100.0	.....	.....	.....	.....	.....	.....
6. Brighton sand	924	25.6	1,788	49.5	528	14.6	372	10.3
7. Brighton gravelly sand	84	32.3	133	50.7	28	10.7	16	6.2
8. Brighton sandy loam	900	47.0	680	36.2	244	13.0	56	3.0
9. Tecumseth sand	212	27.2	356	45.6	212	27.2	.....	.....
10. Tecumseth sandy loam	52	52.0	48	48.0	.....	.....	.....	.....
11. Granby sandy loam	188	12.1	688	44.4	608	39.3	64	4.2
12. Bridgman sand	.....	.....	.....	.....	.....	.....	480	100.0
13. Bottom land	16	1.7	276	29.2	656	69.1	.....	.....
14. Muck	36	4.5	148	18.5	552	69.0	64	8.0
	8,656	39.2	7,832	35.5	4,180	18.9	1,410	6.4

[a] Cropland:

Cropland occupied more than 39% of the area, or 8,656 acres, at the time of the survey. Mixed grains, hay, and hoe crops are the dominant crops grown on this class. A few orchards, as well as a small acreage of tobacco, will be found included with the cropland.

Table 2 shows the distribution of cropland according to soil type. Fifty-nine per cent of the till soils are in cropland which reflects their suitability for growing general farm crops. Low yields and consequent low farm incomes have resulted in a smaller percentage of the sandy soils being cropped at the present time. However, with the introduction of specialized tobacco growing on the Brighton soils in recent years, this series has a much higher potential value for cropland than it previously had.

Forty-one per cent of the till soils that are in cropland at the present time are located on "C" slope class (8-15%). Sheet wash is common on this slope class and special control practices should be applied to arrest the erosion menace.

[b] Permanent Pasture:

Permanent pasture occupies 35.5%, or 7,832 acres of the area. The well drained Pontypool and Brighton soils, the poorly drained outwash sandy soils and Bottom land make up this rather large percentage. Low unprofitable yields from the Pontypool and Brighton soils were doubtless responsible for large acreages of these types being returned to pasture. In recent years the placing of options with a view to establishing tobacco farms on the Brighton series accounts for many of these farms remaining in pasture at the present time. A large percentage of the well drained outwash sandy soil that is in pasture land will be used for specialized farming when the contemplated expansion in tobacco growing takes place.

Drainage limits the usefulness of the Granby and Tecumseth series for the production of general farm crops. Over 40% of these soils are being used for pasture at the present time.

Over 20% of the till soils were under permanent grass cover when the survey was made. This includes steep slopes that serve their greatest usefulness as pasture, as well as areas that could be cultivated to advantage, should the necessity for agricultural expansion occur.

Bottom land which is subject to occasional flooding is in permanent pasture to the extent of 29%.

[c] Woodland:

Woodland occupies 18%, or 4,180 acres of the area. No attempt was made to classify the wooded area into different categories. Table 2 shows the distribution of woodland according to soil type. Only 4.0% of the till soils support a tree cover, under present land use. As a result of cultivation or a combination of cultivation and pasturage, many of the steep slopes of the till soils are severely eroded, making it difficult

to establish an adequate stand of grass on the exposed parent material. Those locations should be reforested.

Over 25% of the Pontypool sand is under tree cover. About one-quarter of the poorly drained outwash sandy soils are contained in the woodland class. Much of the bottom land and the steep Brighton and Pontypool sand along the stream courses will continue to serve their greatest usefulness if left under tree cover. Unless an attempt is made to establish tree cover on the remaining steep slopes of these types, the problem of gully erosion will become increasingly difficult.

Sixty-nine per cent of the Muck is in woodland. There has been no attempt made to develop the muck soils of the area and until such development is deemed necessary, they are most suited to the growing of trees.

A few landowners have set out forest plantations on their less productive sandy soils. This practice is commendable and should be followed by many others in the area. Observations made during the progress of the survey support the recommendation that wooded slopes should not be grazed. If the forest litter and underbrush is destroyed by livestock, sheet wash commences to erode the surface layer of soil.

[d] Idle Land:

Idle land occupied 6.4%, or 1,410 acres of the area. It included land that was not being used for crop, pasture or woodland at the time the survey was made. The shortage of farm help and the lucrative employment being offered in the urban centres has resulted in some farms being abandoned for the present.

Much of the Brighton series that is considered idle now will be tilled again when there is an expansion in tobacco growing.

Bridgman sand, which occupies over 3% of the project area, comprises over 30% of the idle land of the entire area. These blow sand areas are very severely eroded and difficult to manage. Tree planting appears to be the most effective control measure at the present time.

6. EROSION

Of the area studied 35.9% is showing little or no sign of erosion, or has received alluvial accumulation. Most of these areas are contained in the "A" slope group or are areas under forest cover or pasture. Included, also, are the level poorly drained outwash sandy soils, Muck and Bottom land. Slight erosion has affected 27.5% of the area, 24.3% is moderately eroded, and 12.3%, or 2,704 acres, has been severely or very severely eroded. Over 12% of the area, therefore, has already been

damaged by erosion to the extent that it is advisable to remove it from cultivation.

7. RELATION OF EROSION TO LAND USE

A larger percentage of idle land than of any other land use class has been severely or very severely eroded (48.1% of this land use class). 14% of the pasture land has been similarly damaged. On cropland the percentage is only 6%, which indicates that the severely eroded areas have either been abandoned, used for pasture, or reforested. 10% of the woodland has been severely eroded.

[a] Cropland:

As already stated, 39% of the area was in cropland at the time of the survey. Accelerated erosion has affected 76.6% of this area. The remainder (23.4%) is made up of soils contained in the lower slope groups, poorly drained areas and small areas subject to alluvial accumulation. 33.9% of the soils being used for cropland at the present time is slightly eroded. Such land is not seriously damaged, but a large part of it has lost some topsoil and is situated on slopes sufficient to require some protection. 36.7%, or 3,180 acres of cropland, is moderately eroded, having lost from 25-75% of the topsoil, and must be protected if it is to be left in cultivation. 6% of the cropland has been severely or very severely eroded. Located on the "D", "E", and "F" slope groups, it should be retired to permanent cover.

Over 60% of the till soils are in cropland. Due to their rolling topography, and the large percentage utilized for cultivation, they present the greatest erosion control problem in the cropland class. Special attention should be paid to selecting adapted farm crops, suitable rotations and erosion control practices, if these soils are to remain in cultivation.

Sheet erosion has not seriously affected the smoother Pontypool and Brighton types. "C" slopes on the Pontypool type showed severe signs of erosion and combined with low fertility and droughty nature of this type, are not considered suitable for continuous cultivation. The Brighton type, even in the lower slope groups, is susceptible to gully erosion, owing to its proximity to steep banks adjoining stream courses.

[b] Pasture Land:

Pastures for the most part are located on land that was formerly used for crops. Erosion on pasture, therefore, is much more severe than it would have been if the land had been maintained in grass. From

observations made during the progress of the survey, Canada blue and Kentucky blue were the grasses most commonly found on the till soils, while red top was frequently found on the Pontypool and Brighton soils.

Very few attempts have been made to control erosion on pastures or to improve the cover by re-seeding or other practices.

Of the pasture land 37.7% shows little or no signs of erosion, while 28% has been slightly eroded and over 20% moderately eroded. 14% has been severely or very severely eroded.

[c] Woodland:

Woodland occupies approximately 19% of the area. This land use class is made up of cut-over areas, land that was once cultivated and has been allowed to grow to second growth, or has been reforested. Usually the reforested areas had been previously severely eroded by wind and water. Some of the woodland has been heavily pastured and erosion has occurred.

Of the woodland in the project area 60% is unaffected by erosion. Included in this class are the "A" and "B" slopes of the till and fluvio-glacial soils and a large percentage of the outwash sandy soils. 69% of the Muck and Bottom Land mapped in the area is in woodland. None of the poorly drained outwash sandy soils, Muck or Bottom Land are showing signs of erosion.

Only a small percentage of the till soils have been left in forest cover. Some of these have been replanted in recent years, while others have been pastured and have been affected by accelerated erosion.

Much of the Pontypool sand and sandy loam has been cut over and is now covered with second growth. Very few woodlots on this soil type are fenced from livestock, with the result that moderately and severely eroded areas are occasionally found. The Brighton sand and sandy loam along the stream courses are susceptible to both gully and sheet erosion. These steep slopes that have been denuded of their forest cover are severely scarred by erosion. Both the Pontypool and Brighton series are susceptible to wind erosion. Occasionally an attempt is made to reforest and stabilize areas that show signs of shifting, through the action of wind erosion. Such areas are included in the severely eroded class. A large portion of the wooded Bottom Land serves a most useful purpose in acting as a natural barrier by holding back the ice during the spring thaws.

[d] Idle Land:

Under present land use conditions 6.4% of the area is idle land. Almost 50% of this class is severely or very severely eroded. Approxi-

mately 30% is showing little or no signs of accelerated erosion, while 9.1% is slightly eroded and 12.9% moderately eroded.

Of the till soils mapped 176 acres were in this class—only 38 acres were severely or very severely eroded and should be taken out of cultivation. The remainder no doubt will be cultivated again when sufficient help and equipment can be obtained to farm it. However, over 55% of the till soils that are idle now require complex soil conservation measures when cultivated.

About 5% of the Pontypool sand is idle, of which over 50% is severely or very severely eroded. The characteristics that limit the usefulness of this type for crop or pasture are such that under present conditions forest cover is recommended for it. 10% of the Brighton sand lies idle now but much of this is held with a view to growing tobacco on it in the future. The Brighton sand located along the stream courses shows signs of severe erosion. 4% of the Granby is idle but could be used for pasture or woodland.

Bridgman sand which occupies 480 acres or 3.2% of the Project Area, is essentially idle land very severely eroded. All the surface and part of the subsoil is removed and occasionally the parent material is exposed. This type occupies over 34% of the area separated as idle land. Some attempts have been made to retard the shifting of the sand by the planting of trees. In many cases these attempts have met with considerable success. The Bridgman sand presents a most difficult problem in the proper utilization of idle land.

8. RELATION OF EROSION TO SLOPE

Table 3 shows the distribution of erosion according to slope group. An increase in slope results in an increase of surface soil removed through erosive action. Over 80% of the soils that are showing little or no erosion are contained in the "A" slope class. Slight erosion is the most dominant type found in the "B" slope class, while the majority of the moderately eroded soils are contained in the "C" slope class. The high percentage of moderately eroded soils in the "C" slope class may be

TABLE 3—Distribution of Erosion According to Slope Group

	A slopes 0-3%		B slopes 3-8%		C slopes 8-15%		D slopes 15-25%		E slopes 25-35%		F slopes 35% and over		Total
	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%	
Little or no Erosion	5,890	84.3	1,086	15.6	04	.1	....	....	....	....	....	....	6,980
Slight Erosion	286	4.7	3,834	63.1	1,448	23.8	440	7.3	38	.6	28	.5	6,074
Moderate Erosion	....	....	118	2.2	3,900	72.6	1,192	22.2	110	2.1	52	.9	5,372
Severe Erosion	....	....	....	....	192	14.7	642	49.1	424	32.5	48	3.6	1,306
Very Severe Erosion	....	....	....	....	....	....	162	17.6	584	63.6	172	18.8	918

Slope groups not differentiated for Bottom Land 950 acres and Bridgman sand 480 acres.

accounted for by the high percentage of cropland and the dominance of "8-15%" slopes on the till soils. 49% of the severely eroded soils are contained in the "D" slope class, 63% of the very severely eroded soils are found in the "E" slopes. Most of the "F" slopes mapped support a permanent cover of trees and have not been pastured or cultivated.

9. CLASSES OF LAND ACCORDING TO USE CAPABILITY

A Soil Erosion and Land Use Survey is an inventory of land conditions which furnishes a physical basis for planning erosion control measures and improved land use on farms in the area. Each of the factors mapped has significance in the study of soils, erosion processes and conservation practices. So that the results of the survey may be utilized for working out good land use and control of erosion, it is desirable to group the factors mapped into a simple classification that expresses capability of the land for use. A steep slope on a soil type may limit the use that may be made of a certain field, although the same type on a gentler slope may be good for cropland. On the other hand, a gentle sloping field may be too stony or too poorly drained for cultivation. Classification of the land according to its use capability furnishes a convenient summary of the physical features and allows recognition of any factor that may limit the use of the land for farming.

The nature of the soil, as reflected by the characteristics of a soil type, the use that is being made of the land at the present time, the percent slope and degree to which erosion has affected the soil, all influence the nature and intensity of practices that are necessary for conservation and use of land. After these four factors are recognized, they furnish the basis for classification of the land according to use capability. Before any classification is established, it is necessary to decide whether the land is suitable for agricultural use and what kind of farming practices are required, and how intensively they must be applied so that the best use can be made of the soil.

The land in this area was grouped into five categories, on the basis of the physical characteristics which determine its capability for use and conservation. Classes I, II, III include land that is suitable for regular use for crops that require tillage. Classes IV and V are not suitable for continuous cultivation, and are best adapted for pasture or forest land. These five classes, according to use capability, are as follows:

I—Land suitable for cultivation without special practices.

II—Land suitable for cultivation with simple practices.

III—Land suitable for cultivation with complex or intensive practices.

IV—Land not suitable for continuous cultivation.

V—Land not suitable for cultivation.

Characteristics of Land Class I:

The land included in this class is characterized by:

1. Can be cultivated safely and permanently without special erosion control practices.
2. Cultivation is not impeded by any physical condition that would interfere with the use of machinery for tillage.
3. Under ordinary good farming practices will produce moderate to high yields of adapted farm crops.

The "A" and "B" slopes of the till soils are the only types represented in this class, which contains about 2.5% of the soils mapped in the area.

Except for the practices necessary to replace plant nutrients removed by crops and to maintain good soil structure, land of Class I can be used almost without limitations as to the kind of general farm crops grown. Situated on the lower slope groups it is not susceptible to sheet erosion. Surface soil from adjoining areas has not washed on to the land contained in this class to a degree that would affect the production of general farm crops. The physical features of the soils in this land class adapt it for general farming. If the physical features such as drainage, or stoniness, lessen the ability of the soil on the lower slope groups to produce adapted farm crops, it is included with another land use capability class. Under good farm management the land contained in this class will produce moderate to high yields of adapted farm crops.

Characteristics of Land Class II:

Land Class II is characterized by one or more of the following requirements in order to be cultivated safely and permanently with the production of moderate to high yields of adapted farm crops:

1. Maintenance of an adequate supply of organic matter.
2. Removal of stones that might interfere with cultivation.
3. Maintenance of grass cover in natural drainage areas.
4. Installation of tile drains.

About 30% of the soils mapped in the area are contained in Land Class II. The soils of Land Class II must be used more carefully than those of Class I. Simple practices of some kind are necessary, either to

control erosion, to remove some physical obstacle (such as stones or poor drainage), or to improve or maintain the fertility of the soil. The practices required on Class II are simple and easily applied.

Occasionally gullies are found on the till soils included in Class II. Sheet erosion, however, has not seriously affected these soils. From information gathered during the progress of the survey, it was noted that 50% of the farmers on the Bondhead fine sandy loam and the Dundonald sandy loam were using a 3-year rotation (based on interviews with twenty farmers). Only nine of the twenty used alfalfa in their grass seed mixture. Three farmers reported the use of fertilizer supplements. Even on the lower slope groups the lengthening of the rotation, the incorporation of legumes in the grass seed mixture, and a sound soil-building programme should be initiated to arrest the menacing effect of sheet erosion. The till soils are susceptible to gully erosion. Occasionally areas were noted where the natural drainage areas were grassed over; the value of this practice was reflected in the gully erosion control gained by it. Susceptibility to erosion was the most important factor in placing the lower slope groups of the till soils in Land Class II.

In the Pontypool sand, the Pontypool sandy loam, the Brighton sand, Brighton sandy loam, and Brighton gravelly sand, the limiting factors for crop production are low organic matter and low natural fertility. Rye is commonly found growing on the lighter sandy soils, whereas on the till soils it is rarely included in the crop rotation.

From interviews with thirteen farmers on the Pontypool series, it was noted that four included alfalfa with their grass seed mixture; rye was the most common grain crop grown, the average yield of this crop being 14 bushels per acre. One reported using fertilizer supplement. There did not appear to be any definitely established rotation on these sandy soils. Because of the low yields obtained from these soils, it appears necessary for the farmers to till a much larger acreage in order to realize an income comparable with the farmers on the more productive till soils.

The yields on the "A" and "B" slopes of the Brighton series are low Sheet erosion has not seriously affected the Brighton sand and sandy loam contained in Land Class II. Level topography, good internal drainage and freedom from stones make these soils suitable for general farming, provided soil improving practices are applied to build up the fertility level.

Owing to the poor internal drainage the Tecumseth sandy loam is included with Class II. Installation of tile drains would improve this type for the growing of general farm crops.

Characteristics of Land Class III:

The soils included in this class are suitable for cultivation provided complex or intensive practices are employed. In addition to the practices mentioned in Land Class II, it may be necessary to use contour cultivation and strip cropping. This class is characterized by one or more of the following factors:

1. Susceptibility to erosion if cultivated.
2. Some physical obstacle such as stoniness or poor drainage.
3. Requires special soil improving practices for maintaining and conserving the soil.

The conservation and control measures required in Class II are applicable to Class III as well. However, the condition of erosion is more aggravated in this class and the control practices must be increased.

Approximately 20% of the soils mapped in the area are contained in Class III. 35% of the soils are in cropland at the present time and require special erosion control measures if cultivation is continued.

The Bondhead fine sandy loam and Dundonald sandy loam contained in Class III suffer from both gully and sheet erosion. For the most part they are located on "C" (8-15%) slopes. Regardless of slope, these areas of the till soils have been subjected to the same system of rotation and cultural treatment as the lower slope groups, resulting in a loss of 25-75% of the surface soil through sheet erosion. Incorporation of legumes in the grass seed mixture and longer rotation should be adopted on these types. Because of the susceptibility of the till soils to erosion and the degree to which they have already suffered from sheet wash, more intensive control practices are necessary. It is strongly urged that more experimental work be done on these soils to develop methods and technique for practising strip cropping, and contour cultivation applicable to the area.

The Pontypool and Brighton soils contained in Land Class III have been eroded to a greater extent, or are located on steeper slope groups than those represented in Class II.

The poor internal drainage of the Tecumseth sand places it in Class III. Installation of tile drains would greatly increase the capability of this soil for general farm use.

Characteristics of Land Class IV:

The land included in Class IV is not suitable for continuous cultivation and is limited by one or more of the following factors:

1. Steep slopes.
2. Severe erosion.
3. Physical obstacles such as stoniness or poor drainage.
4. Irregular topography.

Over 14% of the soils mapped in the area are placed in Class IV which may be used for controlled grazing. Parts of it may be cultivated occasionally to renew the stand of pasture plants. In spite of severe erosion and steep slopes, the till soils represented in Class IV are capable of supporting good stands of Canada Blue and Kentucky Blue, provided the pastures are not overgrazed.

The "C" slopes of the Brighton gravelly sand and Pontypool sandy loam are also placed in Class IV. Usually the "C" slopes of the Brighton sandy loam occur along stream courses. To arrest gullies cutting back, permanent cover of trees is suggested for these slopes.

Poor drainage limits the extent to which the Granby sandy loam can be used for producing general farm crops. Characterized by level and depressional topography, it is very difficult to tile drain this type. Capable of producing good stands of pasture, it is placed in Class IV. Part of the Bottom land was placed in this class also.

Characteristics of Land Class V:

The land included in this class is not suitable for continuous cultivation and is limited by one or more of the following factors:

1. Steep, rough or broken topography.
2. Extreme stoniness.
3. Very severe erosion.
4. Very poor drainage.
5. Very low fertility.

Of the area mapped 32% is included in Land Class V, for which forest cover is recommended. This area is made up of "D" slopes (15-25%), of the soils from which over 75% of the topsoil has been removed, all slopes over 25%, the Pontypool sand with the exception of the "A" and "B" slopes, the steep slopes of the Brighton located along the stream courses, Muck, Bottom Land and Bridgman sand.

10. RELATIONSHIP OF PRESENT LAND USE AND LAND USE CAPABILITY CLASSES

Table 4 shows the use capability of the land in the area. On the basis of physical factors, 47.5% of the area is not suited for continuous

TABLE 4—Land Use Capabilities According to Present Land Use

	I		II		III		IV		V		Total	
	Acreage	%	Acreage	%	Acreage	%	Acreage	%	Acreage	%	Acreage	%
Cropland	288	3.3	3,404	39.3	3,028	35.0	796	9.2	1,140	13.2	8,656	39.2
Pasture Land	212	2.7	2,148	27.5	960	12.3	1,580	20.1	2,932	37.4	7,832	35.5
Woodland	44	1.1	524	12.5	396	9.4	840	19.2	2,416	57.8	4,184	18.9
Idle Land	.....	....	472	33.5	120.	8.5	88	6.3	728	51.7	1,408	6.4
	544	2.4	6,548	29.6	4,504	20.5	3,268	14.8	7,216	32.7	22,080	100.0

cultivation for the production of general farm crops. Of this area, about one-third may be used for occasional cultivation but should be devoted primarily to permanent pasture.

Cultivated crops may be grown on the remaining 52.5% of the area. 20.5% of the area requires complex control measures, while 29.6% requires simple practices. Only 2.4% of the area can be cultivated without erosion control or soil building practices of some kind.

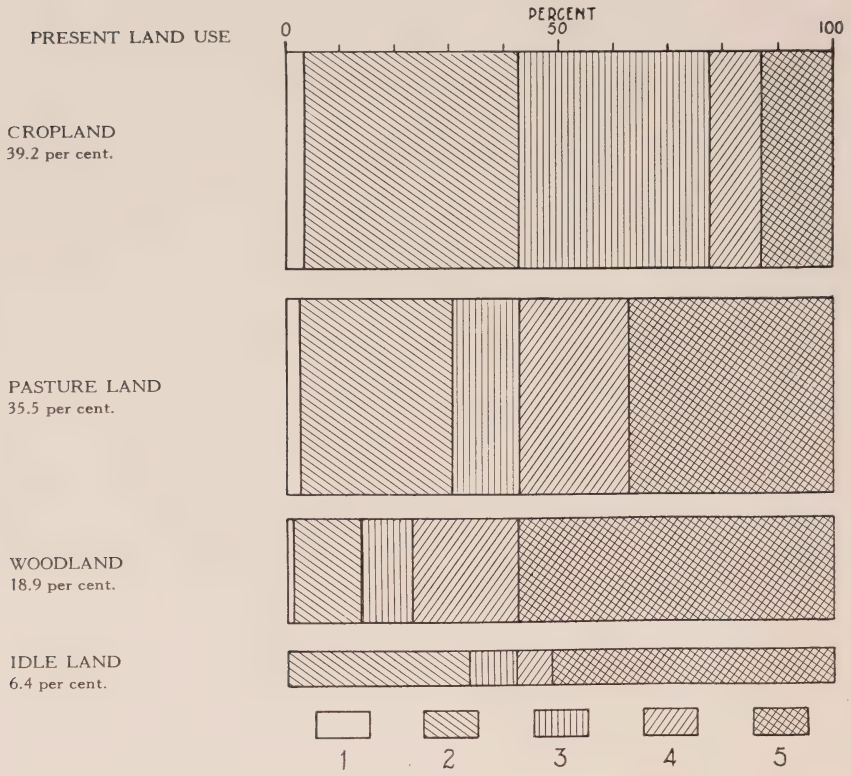
The degree of success or failure a farmer attains depends primarily on the soil type on which he is located. A definite correlation exists between crop yields and soil type. The average yield of mixed grain grown on the following soil types was:

Bondhead fine sandy loam....38-40 bushels per acre.
Dundonald sandy loam.....34 bushels to the acre.
Pontypool sand.....20-24 bushels per acre.

The average yield of rye grown on the Pontypool sand ranges from 11-15 bushels per acre. On the more productive till soils, this crop was rarely grown because the land owner felt that this soil could be used to better advantage. Low crop yields and low incomes have resulted in abandonment of many of the farms located on the Pontypool sand and Pontypool sandy loam. Failure to produce satisfactory yields of general farm crops resulted in much of this land being placed in permanent pasture. Insufficiently fertile to produce a stand of pasture that would permit continuous grazing and form a protective cover for the soil, the surface began to break and wind erosion resulted.

Table 4 presents data on the use capability of the present land use classes. This information is summarized in graphic form on Page 140. Of the present cropland, 9.2% falls in capability Class IV and 12.3% in capability Class V and should be removed from cultivation as soon as possible. Furthermore, 35% of the present cropland is in Class III, on which the most careful and intensive conservation measures are required to prevent further damage by erosion. This class included slopes up to 15% and some more gentle slopes that have lost over half of the topsoil. Active gullying has occurred on some of the land included in this class.

CLASSES OF LAND ACCORDING TO USE CAPABILITY



Relationship of Land Use Capability Classes and Present Land Use Classes. Classes 1, 2, 3 are suitable for cultivation, Class 1 without special practices, Class 2 with simple practices, and Class 3 with complex or intensive practices, Class 4 is suitable for only occasional or limited cultivation, Class 5 is not suitable for cultivation.

Over 42%, or 3,320 acres, of the land in permanent pasture is suitable for cultivation. The reason for this rather high percentage can be attributed to the large acreage of the well drained outwash sandy soils that are in pasture at the present time. Options have been taken on fairly large acreages of these soils for the growing of tobacco.

A considerable area (23%) of the land which is at present under forest use could be used for the production of general farm crops. But 99% of this potential agricultural land falls into the land use Classes II and III, which require soil conservation practices. For this reason it would be advisable to leave this land under forest, at least until such time as soil erosion has been brought under control on the already cleared land.

Forty-two per cent of the land that is idle at the present time is contained in Land Classes I, II and III. As suggested earlier in the

report, present labour conditions and options placed by prospective tobacco growers on suitable tobacco soils are responsible for a large percentage of this idle land. However, over 50% of the idle land in the area is very severely eroded and should be retired to permanent grazing.

The necessary adjustments on individual farms, in order to carry on farming operations within the limits set by the use capability of the land, will present many difficulties. Many factors beyond the scope of this report will enter into the final solution of these problems. However, all plans that are made should be within the physical capability of the land for use.

11. SUGGESTED USE OF THE SURVEY

The Soil Erosion and Land Use Survey furnishes a basis for the development of plans for the conservation of soil through improved land use and for the application of soil-conserving practices on farms. With this detailed inventory, technicians should be able to devise cropping plans that would make good use of all land. The recommendations suggested under the five land use capability classes are of necessity general in nature. Specific knowledge of actual conditions, field by field, is required for detailed planning on farms. Recommendations must be made for each farm as a unit and the various protective measures that are discussed in this report must be fitted together into an acceptable farm plan. The plan must be satisfactory to the farmer and at the same time it must provide for practices that will control erosion and run-off water. The characteristics of the land must be determined and, so far as possible, each acre should be put to the highest or most profitable use of which it is capable.

The survey has recorded in detail the extent to which erosion, in its various forms, has affected the area. The results are indicative of the urgent need for a well-defined and active soil conservation programme. If erosion is allowed to go unchecked, further reduction in crop yields, crop failures, and increased land abandonment may be expected. Erosion can be controlled, and greater returns can be obtained from the land, if soil-saving and soil-improving measures are carried out.

CHAPTER TWELVE

Economic Aspects of Agriculture

IN THE proposed Ganaraska Forest Area of Hope and Clarke Townships, there are approximately 20,000 acres of land. Much of this area is now woodland but a large proportion of it is being farmed. In order to show the productivity of these farms, a special analysis has been made of the information obtained from 49 farmers who are located wholly or partially in this area. These records for the year 1942 were obtained as part of a larger survey that included all the farms in the Ganaraska Watershed.

The 49 farms for which information will be shown do not represent all the farms in the area; but they do include most of them and give an excellent cross-section of the type of agriculture which is being carried on. Much of the farm land in the Ganaraska Forest Area is owned by farmers living outside the area and is used for pasture or woodlots. These parcels have not been considered in the tabulations and only those farms having crop land are included in the analysis.

Members of the staff of the Economics Division, Dominion Department of Agriculture, used a questionnaire as a basis for the data on which this analysis was made. Besides these interviews with individual farmers, information was also obtained through the courtesy of the Dominion Bureau of Statistics. In addition, information on taxes and assessment was supplied through the co-operation of W. W. Lord, and J. J. Mellor, clerks of Hope and Clarke Townships respectively.

1. TYPES OF FARMING

[a] Crops:

General farming is the prevailing type of agriculture carried on in the northern section of Hope and Clarke Townships. The crops grown on the 49 farms, based on the three year average 1940-42, are shown in Table 1.

Mixed grain and oats average 24.7 acres per farm or 33.8 per cent of total land in crop. Mixed hay and alfalfa averaged 21.4 acres per farm and the rye acreage totalled 12.6 acres. The average farm in the area had 206 acres of land, 73 acres of which were cropped and 100 of which were improved with the balance of 106 acres in forest, unimproved pasture and waste land.

TABLE 1—Crop Acreage 1940-1942

Use of Land	Total 49 Farms, Acres	Average per Farm, Acres	Per Cent of Total Crop Land
Mixed Grain and Oats	1,212.5	24.7	33.8
Wheat	175.9	3.6	4.9
Corn	103.6	2.1	2.9
Rye	618.6	12.6	17.2
Hay—mixed	909.3	18.6	25.5
alfalfa	135.5	2.8	3.8
Potatoes	94.1	1.9	2.6
Roots	22.2	.5	.7
Fruits and Vegetables	40.4	.8	1.1
Other Crops	267.3	5.5	7.5
Total Crops	3,579.4	73.1	100.0
Rotation Pasture	1,052.1	21.5	....
Other Improved	267.4	5.4	....
Total Improved Land	4,898.9	100.0	....
Unimproved	5,195.5	106.0	....
Total Land in Farms	10,094.4	206.0	....

[b] Sources of Income:

Few crops were sold from the area in 1940 but were used mainly as feed for live stock (Table 2). Crop sales per farm averaged $86, potatoes being the most important single cash crop.

TABLE 2—Sources of Income, 1940

Source of Income	Sales	Average per Farm	Percentage
	$	$	%
Crop Sales	4,229	86	9.5
Live Stock Products	12,348	252	27.8
Live Stock—alive	21,736	444	48.9
dead	1,199	24	2.6
Forest Products	2,393	49	5.4
Fruits and Vegetables	830	17	1.9
Other Sources of Income	1,699	35	3.9
Total Revenue	44,434	907	100.0

Cattle are mainly of the dual purpose type and the cream produced is sold to creameries and skim milk is fed to live stock. Cattle, hog and other live stock sales averaged $468 per farm and were slightly more than 50 per cent of the total revenue obtained from all sources. Receipts from other sources of income, including outside work, averaged $35 per farm. Total receipts for the 49 farms in the area totalled $44,434 in 1940, or an average of $907 per farm.

[c] Capitalization:

Total value of the 49 farms as reported by the owners was $186,750, an average capitalization of $3,811 per farm. Buildings alone were capitalized at $103,020. Total farm valuation ranged from $400 to $10,000, with 90% of the farms capitalized at $6,000 or less.

[d] Assessment:

All parcels of land in the two townships of Hope and Clarke have been assessed for taxation purposes by township assessors. This assessment is used as a basis for taxation for county, school and other taxes. In the proposed forest area there are approximately 19,700 acres of taxable land, not including the land in the county forest.[1] Of this total, 8,000 acres are in Hope and 11,700 in Clarke. The range of assessment per acre for 1941 for all land (not including buildings) is shown in Tables 3a, 3b and 3c.

TABLE 3a—Assessed Value of Land, Hope Township, 1941

Assessment Range, Per Acre	Acres	Per Cent	Value	Per Cent
		%	$	%
Under $4.00	650	8.1	2,208	3.4
$4.00—$5.99	1,349	16.9	6,038	9.4
$6.00—$7.99	2,835	35.4	17,787	27.8
$8.00—$9.99	1,215	15.2	11,070	17.3
Over $10.00	1,955	24.4	26,895	42.1
Total	8,004	100.0	63,998	100.0

In Hope Township, 60 per cent by acreage and 40 per cent by value of all land in the proposed area was assessed at less than $8.00 per acre—25% of the acreage or approximately 2,000 acres was assessed at more than $10.00 per acre.

TABLE 3b—Assessed Value of Land, Clarke Township, 1941

Assessment Range, Per Acre	Acres	Per cent	Value	Per Cent
		%	$	%
Under $4.00	5,232	44.8	14,673	25.5
$4.00—$5.99	2,892	24.8	14,333	24.9
$6.00—$7.99	1,765	15.1	11,721	20.4
$8.00—$9.99	1,060	9.1	8,980	15.6
Over $10.00	720	6.2	7,844	13.6
Total	11,669	100.0	57,551	100.0

[1]Durham County Forest, 1,074 acres.

In Clarke Township 75 per cent by acreage and 70 per cent by value of all land in the proposed area was valued by the assessor at less than $8.00 per acre, while 6.2 per cent of the acreage, or 720 acres, was assessed at more than $10.00 per acre.

TABLE 3c—Assessed Value of Land, Hope and Clarke Townships, 1941

Assessment Range, Per Acre	Acres	Per Cent	Value	Per Cent
		%	$	%
Under $4.00	5,882	29.9	16,881	13.9
$4.00—$5.99	4,241	21.6	20,371	16.7
$6.00—$7.99	4,600	23.4	29,508	24.2
$8.00—$9.99	2,275	11.5	20,050	16.6
Over $10.00	2,675	13.6	34,739	28.6
Total	19,673	100.0	121,549	100.0

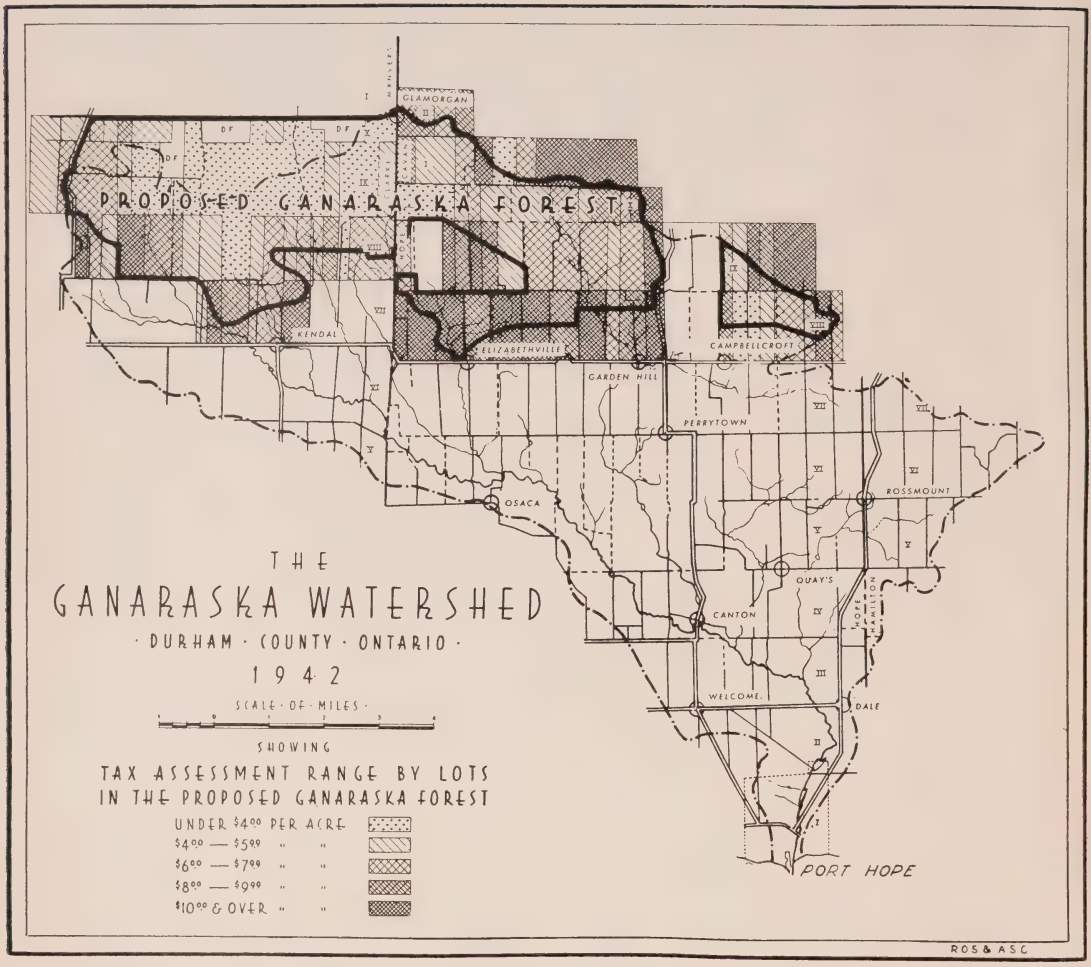
Total assessed value of all taxable land in the two townships is $121,549 for the 19,673 acres, averaging slightly more than $6.00 per acre. The average assessed value of the proposed forest area land in Hope was $7.70 per acre and in Clarke $4.90 per acre. Nearly 14 per cent or 2,675 acres were assessed higher than $10.00 per acre.

A map has been drawn of the forest area showing the range of assessment by individual parcels of land (page 146). In cases where the proposed line cuts through lots, the assessment for the whole lot is averaged.

Buildings were assessed at $41,611 or slightly more than 25 per cent of the total assessment. Buildings in Hope were assessed at $18,660 and in Clarke at $22,951. The total taxes payable for 1941 for all land and buildings in the proposed forest area are estimated at $3,400.00.

2. PRODUCTIVITY OF LAND

One measure of farm productivity is the net cash income or the amount of money available to the farmer after all farm expenses have been paid. This is the amount of cash he has available to himself and family for food, clothing, fuel and other cash expenditures. In 1940 the average net cash income per farm averaged $459 for the 49 farms in the area. With an average of 1.5 workers per farm this means a net cash income per worker of $315 per year. In 1940 the average cash wages paid to male hired help in Ontario as reported by the Agricultural Branch of the Dominion Bureau of Statistics, was $289 per year.



The crop index[1] on the 49 farms for the three years 1940-1942 averaged 87.3, compared with 100.0 for all farms in the Ganaraska Watershed. In other words, the average yield of all crops in the proposed forest area was 13 per cent below the average of the whole watershed area. Oats averaged 26.2 bushels per acre, mixed hay 1.5 tons per acre, and potatoes 58.7 cwt. per acre.

The average number of animal units per farm was 22.4 An animal unit is one mature cow or horse or the equivalent of other live stock

[1]The crop index is a means by which crop yields per acre for all crops are put on a common basis. Thus a comparison of indexes on individual farms is a method of comparing efficiency in the use of land devoted to crops. Average crop yields for the Ganaraska Watershed in this instance are used as a basis and have an index of 100. Crop indexes of more than 100 represent better than average yields, while those less than 100 represent yields that are below average.

kept on the farm for a year, and is based on the amount of feed required and manure produced during the year.

Size and condition of buildings in general is a third measure of the productivity of land. As part of this survey, all barns and houses in the two townships of Hope and Clarke were classified on the basis of their condition into five different classes, ranging from poor to excellent. Altogether there were 124 usable houses and barns in the area and the condition of these is shown in Table 4.

TABLE 4—Condition of Occupied Houses and Barns and Percentage in Each Class

Condition of Buildings	Houses		Barns		Total	
	No.	%	No.	%	No.	%
Occupied:						
Excellent	1	1.8	..	....	1	.9
Good	2	3.5	2	3.7	4	3.6
Fair to Good	16	28.1	15	27.8	31	27.9
Poor to Fair	13	22.8	23	42.6	36	32.4
Poor	25	43.8	14	25.9	39	35.2
Total Occupied	57	100.0	54	100.0	111	100.0
Unoccupied but Usable	6	....	7	....	13	....
Total Usable Buildings	63	....	61	....	124	....
Abandoned—Not Usable	6	....	5	....	11	....
Buildings Levelled	13	....	20	....	33	....

More than 65 per cent of the dwellings were classed in the two lowest groups. Condition of barns shows a similar situation, with 68 per cent classified as either poor or poor to fair. Of the total of 124 usable buildings, 111 were occupied, while 13 were unoccupied. In addition to these usable buildings, there were 11 abandoned buildings that were not usable and 33 buildings which had been levelled with only the foundation showing.

3. SOIL GROUPS IN RELATION TO RETURNS AND YIELDS

Soil is a limiting factor in agricultural development in any farming area. The types of soil to be found in the area have been discussed in another section of the report and no further interpretation is necessary. The soil types in the county have been given a productivity rating on the basis of their internal and external features, and have been grouped into four classes, using this rating.[1]

Each of the 49 farms in the area was located on a soil map and the number of acres in each soil group shown for each farm. No land in the

[1] "The Soils of Durham County," by L. R. Webber and F. F. Morwick. (Unpublished).

The average level of living for a good many farmers in the proposed forest area is so low that insufficient necessities are obtained, and almost nothing in the way of advancement goods and recreation, which are considered as part of the Canadian level of living,—The 8th Concession of Clarke.

proposed forest was classed in either of the two highest soil groups, 24.7 per cent was classed as fair on the basis of soil productivity, 6.5 per cent was classed as poor to fair, and 67.8 per cent was poor, with the remaining 1.0 per cent classed as waste. The 49 farms have been grouped on the basis of the number of acres of fair soil on each farm; those with 25 acres or more in one group, and those with less than 25 acres in the other.

To eliminate the influence of the size factor, each of these groups was redivided on the basis of size. Results for each group have been tabulated and the resulting information is shown in Tables 5 and 6.

It would seem from these figures that soil in this area has very little influence on net cash income or on the crop index (Table 8). The reason soils do not show a greater influence on productivity in this area probably is that none of the soil in the proposed area can be classed as good agricultural soil and the attempt made here to differentiate between yields on different soil types seems impractical within such a limited range.

TABLE 5—Receipts, Expenditures, Net Cash Income, and Size of Farm, on Different Soil Groups

	200 Acres and Less		More than 200 Acres	
	25 Acres or Less Fair Soil	More than 25 Acres Fair Soil	25 Acres or Less Fair Soil	More than 25 Acres Fair Soil
Number of Records	17	11	9	12
Total Acres in Crop	53.1	74.7	89.8	87.2
Total Acres in Farm	127.0	168.2	272.4	302.7
Receipts per Farm	$651.00	$775.00	$966.00	$1,346.00
Expenditures per Farm	337.00	452.00	315.00	702.00
	$314.00	$323.00	$651.00	$644.00
Per cent of Land in:				
Mixed Grain	34.1	35.8	28.8	35.4
Wheat	5.5	6.6	3.8	3.7
Corn	2.6	2.8	2.7	3.3
Rye	12.2	9.5	28.5	17.8
Hay and Alfalfa	27.1	33.8	23.9	29.9
Potatoes	3.5	1.5	3.3	2.1
Animal Units	15.0	21.6	28.2	29.4

Yields of corn and mixed grain are somewhat higher on the farms with the better soil but alfalfa and potatoes had better average yields on the farms with the lighter soil which is classed as poor.

TABLE 6—Yields, Crop Index and Man Equivalents[1] on Different Soil Groups

	200 Acres and Less		More than 200 Acres	
	25 Acres or Less Fair Soil	More than 25 Acres Fair Soil	25 Acres or Less Fair Soil	More than 25 Acres Fair Soil
No. of Records	17	11	9	12
Yield per Acre:				
Mixed Grain and Oats	26.5	27.5	22.2	27.5
Wheat	21.0	21.0	23.6	25.9
Corn	5.7	8.5	4.8	6.9
Rye	11.8	12.3	12.2	12.1
Hay	1.38	1.52	1.57	1.56
Alfalfa	2.7	1.6	2.0	1.7
Potatoes	56.9	48.0	63.7	61.2
Crop Index	86.3	87.6	84.0	90.0
Man Equivalent	1.2	1.4	1.7	1.6

[1]A man equivalent represents one man working on the farm for a twelve-month period.

A higher percentage of rye is grown on the farms with the poorer soil and in case of the 9 farms over 200 acres, 28.5 per cent of the crop land was planted to rye as compared with 28.8 per cent for mixed grain. These tables merely tend to show that soil type does influence the type of crop that can be grown, but the farmer makes allowances for such soils and grows those crops for which the market demand is greatest and which are best suited to the soil on his farm.

4. SIZE OF FARM IN RELATION TO RETURNS AND YIELDS

The average size of farm in Durham County, as reported in the 1931 Census of Agriculture, was 112 acres, of which 77 acres were improved. The average size of the 49 farms in the proposed forest area was 206 acres, with 100 acres of improved land per farm. This large acreage per farm represents an extensive type of farming for Ontario but is apparently necessary in this area in order to maintain at least a subsistence level of agriculture. Of the 49 farms, 11 had less than 125 acres, 22 reported between 126 and 250 acres per farm, while 16 farms had more than 250 acres of land. For the purpose of analysis the information for each of these three groups is shown separately in Tables 7 and 8.

TABLE 7—Crop Acreage, Yields, Number of Man Work Units and Animal Units on Different Size Groups of the 49 Farms

Size of Farm	Under 126 Acres	126-250 Acres	Over 250 Acres	Total Acres
Number of Farms	11	22	16	49
Size of Farm, acres	96.4	180.2	316.8	206.0
Acres in Crop, acres	42.1	74.2	92.7	73.0
Yield of Oats per Acre, bushels	26.1	26.1	26.4	26.2
Yield of Hay per Acre, tons	1.18	1.54	1.57	1.51
Yield of Potatoes per Acre, cwt.	50.1	54.5	65.1	58.7
Crop Index per Farm	86.6	85.9	89.3	87.3
Man Work Units per Farm	210	335	417	333
Animal Units per Farm	12.6	23.3	28.0	22.4
Man quivalent per Farm	1.0	1.5	1.8	1.5
Work Units, per Man Equivalent[1]	210	223	232	229

As the size of farm increased, the average acreage in crops increased. Yields showed very little variation for the different size groups with crop

[1]Work Units per man equivalent are the total number of productive man days divided by the number of man equivalents. A productive man work day is a measure of the amount of productive work performed on the farm or group of farms based on average standards of labour requirements for an acre of crop or a head of livestock.

indexes for the three years averaging from 85.9 to 89.3. The crop index was based on yields of all crops grown and not only the three shown in the table. The average yield of hay does not include alfalfa which was grown more extensively on the small farms than on the larger ones.

As the size of farm increased, the number of acres in crop increased, as also did the average number of animal units. The increase in crops and animals required an additional number of workers per farm with the smallest farms requiring an average of 1.0 man per farm, and the largest farms averaging 1.8 men per farm for the year. However, the amount of work performed per man increased as size increased, and the workers on the large farms averaged 232 man work days per year, compared to 210 for the small farm group.

TABLE 8—Capitalization, Receipts, Expenditures, Net Cash Income on Different Size Groups of the 49 Farms

Size of Farm	Under 126 Acres	126-250 Acres	Over 250 Acres	All Farms
Number of Farms	11	22	16	49
Size of Farms, acres	96.4	180.2	316.8	206.0
Capitalization:				
Land and Buildings	$2,491	$3,757	$4,794	$3,811
Buildings	1,620	1,959	2,631	2,102
Capitalization per Acre	26	21	15	18.5
Receipts	$590	$868	$1,178	$907
Expenditures	346	437	533	448
Net Cash Income per Farm	$244	$431	$645	$459
Net Cash Income per Man	248	292	367	315

As the size of the farm increased, the value not only of the farm itself, but also the value of the buildings increased. The eleven small farms having less than 125 acres averaged $2,491 per farm and the building valuation was placed at $1,620. On the 22 farms falling in the middle group, the average value of the farm was $3,757, with buildings valued at $1,959, while on the 16 largest farms the total value averaged $4,794 and buildings averaged 2,631. However, as the size of farm increased, the farm valuation per acre decreased from $26 to $15.

Receipts, expenses and net cash income per farm increased as the size of the farm increased (Table 8). The average net cash income on the smallest farms was $244 per farm for the year 1940 or $248 per worker. The net cash income increased to $645 on the farms over 250 acres but the net cash income per worker increased to only $367 for the year. It would seem from these figures that even on the larger farms in the area the type of agriculture carried on does not allow more than a subsistence standard of living.

5. CROP INDEX IN RELATION TO RETURNS, CAPITALIZATION AND SIZE OF FARM

The crop index for the 49 farms in the area averaged 87.3 or approximately 13 per cent below the average for the Ganaraska Watershed. Ten farms had a crop index for the 3 years 1940-1942 lower than 75.0, sixteen ranged between 75 and 85, seven had indexes between 85 and 95, while sixteen of the 49 records had a crop index higher than 95. Records for each of these farm groups have been analysed and information on the farms in each group shown in Tables 9 and 10.

TABLE 9—Crop Acreage and Yields, Number of Man Work Units and Animal Units in Different Crop Index Groups of the 49 Farms

Crop Index	Under 75	75.1 -85	85.1 -95	95.1 Over	All Records
Number of Records	10	16	7	16	49
Size of Farm, acres	146.2	214.7	244.3	217.9	206.0
Acres in Crop, acres	57.0	73.3	95.2	73.1	73.0
Yield, Oats per Acre, bushels	18.9	23.1	27.7	32.2	26.2
Yield, Hay per Acre, tons	1.21	1.42	1.43	1.78	1.51
Yield, Potatoes per Acre, cwt.	48.7	55.4	63.2	68.8	58.7
Crop Index	63.1	80.3	90.6	106.0	87.3
Man Units per Farm	252	337	409	347	333
Animal Units per Farm	16.6	22.0	27.2	24.5	22.4
Man Equivalent per Farm	1.2	1.4	1.7	1.6	1.45

Yields of oats, hay and potatoes for each group show that as the yields increased the crop index increased proportionately. The ten farms having the lowest crop indexes averaged only 57 acres and 16.6

TABLE 10—Capitalization, Receipts, Expenditures and Net Cash Incomes in Different Crop Index Groups on the 49 Farms

Crop Index	Under 75	75.1- 85.0	85.1- 95.0	95.1 Over	All Records
Number of Records	10	16	7	16	49
Capitalization:					
Land and Buildings	$2,790	$3,319	$4,286	$4,734	$3,811
Buildings	1,520	2,145	2,114	2,419	2,102
Receipts per Farm	$554	$933	$817	$1,140	$907
Expenditures per Farm	292	518	299	541	448
Net Cash Income, per Farm	$262	$415	$518	$599	$459
Net Cash Income, per Man	$212	$308	$302	$394	$315

animal units per farm; while the sixteen farms with the highest crop indexes averaged 73 acres in crop and 24.5 animal units per farm.

The most reliable measure of productivity for any one year is the net cash income and as the crop index increased the net cash income per farm and per worker increased. For the low crop index group, the average net cash income per man averaged only $212, and this increased to $394 per year for the group having a crop index of over 95. However, even the average net cash income for the highest group does not give more than a subsistence standard of living.

6. NET CASH INCOME IN RELATION TO RETURNS AND CAPITALIZATION

As has already been stated, the net cash income is a good measure of productivity. When grouped on this basis, 18 farms showed a net cash income of less than $300 in 1940, 15 farms averaged between $301 and $600, and 16 farms had more than $600. Of the latter, only 4 farms had a net cash income of more than $1,000.

TABLE 11—Crop Acreage, Yields, Number of Man Work Units and Animal Units in Different Net Cash Income Groups of the 49 Farms

Net Cash Income	Under $300	$301-$600	Over $600	All Farms
Number of Farms	18	15	16	49
Size of Farm, acres	190.6	173.2	255.0	206.0
Acres in Crop	67.6	67.3	84.6	73.0
Yield of Oats, bushels	26.2	25.9	27.8	26.2
Yield of Hay, tons	1.43	1.40	1.69	1.51
Yield of Potatoes, cwt	50.8	53.9	69.0	58.7
Crop Index	82.3	86.5	92.8	87.3
Man Work Units per Farm	270	328	410	333
Animal Units per Farm	15.8	23.1	29.3	22.4
Man Equivalent per Farm	1.2	1.5	1.7	1.45
Work Units, per Man Equivalent	229	220	236.4	229

Yields of crops and the number of animal units on the farm have a marked influence on the net cash income. On the 18 farms where the net cash income was less than $300, the crop index was 82.3 and the number of animal units per farm was only 15.8. The average net cash income per farm for this group averaged $46 and the net income per man averaged $40. (Table 12.)

Many roads which formerly were well travelled and served the early communities, are now impassable due to drifting sand.

TABLE 12—Capitalization, Receipts, Expenditures, and Net Cash Income per Farm and per Man by Different Income Groups on the 49 Farms

Net Cash Income	Under $300	$301-$600	Over $600	All Farms
Number of Farms	18	15	16	49
Size of Farm	190.6	173.2	255.0	206.0
Capitalization:				
Land and Buildings	$3,283	$3,593	$4,609	$3,811
Buildings	1,891	2,158	2,288	2,102
Receipts per Farm	$484	$822	$1,461	$907
Expenditures per Farm	438	388	516	448
Net Cash Income per Farm	$46	$434	$945	$459
Net Cash Income per Man	$40	291	545	315

On the 15 farms from which the net cash income ranged between $301 and $600, the crop index increased to 86.5, and the number of

animal units to 23.1 These farms averaged 1.5 workers per farm and the net cash income per man totalled $291. These farms were approximately the same size as the lower group and had the same acreage in crops. For the group with the highest net cash income the crop index was 92.8 and the animal units increased to 29.3 per farm. The net cash income per worker on these 16 farms averaged $545.

As the net cash income increased, the valuation of the farm and buildings increased. It might be noted that there is very little difference in the amount of productive work done per man in any of the three groups. In other words, there are just as many men per farm on the farms where the net cash income per man averages $40, as on those where the average is $545.

7. CONDITION OF BUILDINGS IN RELATION TO RETURNS AND CAPITALIZATION

The condition of barns and houses in the area has been discussed in previous sections, but in order to relate the condition of the farm buildings as a unit to the farm enterprise, the house and barn have been grouped together as a farmstead and classed as either poor, poor to fair, fair to good, or good. Farmsteads on 11 of the 49 farms were classed as poor, 19 were poor to fair, 17 were fair to good, and only 2 farms rated good on the basis of both house and barn. For the purpose of analysis, the two farms with good buildings have been grouped with the 17 in the fair to good class. In each group the condition of the farm buildings gave a good indication of size of enterprise, value of farm, and productivity. (Table 13.)

TABLE 13—Condition of Farmstead Related to Size of Farm, Capitalization and Crop Index

Condition of Buildings	Poor	Poor to Fair	Fair to Good	All Farms
Number of Farms	11	19	19	49
Acres per Farm	171.0	200.3	232.0	206.0
Capitalization:				
Land and Buildings	$1,959	$3,405	$5,289	$3,811
Buildings	900	1,751	3,492	2,102
Crop Index	79.3	84.5	92.3	87.3
Man Units per Farm	299	310	377	333
Animal Units per Farm	19.0	21.9	25.0	22.4

The 11 farms with the poorest buildings averaged 171 acres and were valued at less than $2,000; buildings alone, including both house

Every deserted homestead—left of centre—is an unwritten story of hope, toil and disappoint
ings are classed as fair or poor, and that forty-four buildings have been

and barn, were valued at $900. In this same class the crop index was only 79.3 and an average of 19.0 animal units were carried on each farm. The 19 farms with buildings ranging from poor to fair averaged 200 acres and had an average value of approximately $3,405 for the farm and $1,750 for buildings. The crop index for these farms averaged 84.5. The 19 farms with fair to good farmsteads had an average value of $5,300 and a crop index of 92.3.

8. FAMILY FARM LIVING EXPENSES, 1942

Some understanding of the level of living which results from agriculture in the area may be obtained from the analysis of the family living expenses collected during the survey. The cash expenditures per farm can be considered as a measure of the purchasing power which results from farming in this area. They differ from net cash income for individual families by the amount of savings or current indebtedness which occurred during the year, but averaged over all the families in the sample, the family expenses will measure income as well as cost of living.

For purposes of comparison, the expenditures of the 115 families living outside the forest area of the watershed have been analysed, as well as those of the 33 families living within its boundaries. The average

ment. The economic survey of the proposed forest area shows that seventy-five farm build-abandoned or levelled—The town line between Hope and Clarke.

living expenses of all the families in the watershed were $594 during the year of the survey.[1] The forest area families spent $110 less than this, or $484, while the families outside the area spent $626 (Table 14). The average size of the families in the two areas was so nearly equal that it was not necessary to adjust the expenditure figures to compensate for this factor. With children under 14 years of age counted as one-half an adult, there were 3.2 adult equivalents in the forest area and 3.4 in the families outside.

The lower incomes of the families in the forest area resulted in their use of less goods and services than the other 115 families, in all of the items listed in Table 14. Less food was purchased, less clothing, and less money was available for recreation and advancement goods.[2] In addition, the forest area farms were less well equipped with some of the conveniences which contribute to the modern level of living.

Only 10 per cent had electricity in the home, as compared with the 30 per cent of the other 115 families; the percentage of telephones was the same in both groups, 66 per cent; but 61 per cent of the families

[1]October 1st, 1941, to September 30th, 1942.

[2]Church donations and car expenses were included in advancement goods because, besides their normal position in the budget, they contribute to personal contacts among rural people which compensate for privileges not found in rural areas.

outside the forest area had automobiles for family use, as against 40 per cent of the families living within the forest area. These are not all the conveniences which contribute to the level of living, and there are also factors which modify the use of the ones considered. Electricity is not always available even if subscribers are able to pay for the service, and lack of adequate roads may curtail the use of cars. However, in this case the data indicate a difference in level of living between the two groups.

TABLE 14—Average Living Expenses on 33 Farms in the Forest Area and 115 Farms Outside the Forest Area in the Ganaraska Watershed, 1942

	33 Forest Area Farms	115 Farms Outside the Forest	All Farms
	$	$	$
Groceries	184	212	206
Fruits and Vegetables	8	11	10
Dairy Products	34	40	39
Meat	28	37	35
Total Food	254	300	290
House Operating Expenses[1]	43	66	61
Clothing	80	100	95
Total Necessities[2]	377	466	446
Advancement Goods	74	119	109
Recreation	33	41	38
Total Expenses	484	626	593

To return to the living expenses, it should be pointed out that low incomes not only limit the goods and services which can be purchased, but also force the expenditure of a large part of the income for physical necessities, leaving small amounts for recreation and advancement goods. The high level of living associated with western civilization has been accompanied by a decline in the proportion of the family budget taken up by food and shelter and an increasing expenditure for advancement and recreation goods.

This relationship is illustrated to a limited extent in the two groups of families under consideration. The families in the forest area, with the lower incomes, devoted 79 per cent of their income to necessities, while the 115 families spent 75 per cent for these same needs (Table 15). These figures are not greatly different, which leads to the inference that the pressure of living is almost as great on the latter families as on the

[1]Includes expenditures for light, heat, telephone, new furnishings and miscellaneous housekeeping expenses.

[2]Includes expenditures for education, insurance, church and charity and automobile operating.

former. In other words, if the income of the 33 forest area farms could be brought up to that of the group with which they are being compared, the additional money would be largely spent for food and clothing.

TABLE 15—Percentage Distribution of Living Expenses on 33 Farms in the Forest Area and 115 Farms Outside the Forest Area of the Ganaraska Watershed, 1942

	33 Forest Area Farms	115 Farms Outside the Forest Area	All Farms
	%	%	%
Groceries	38	35	35
Fruits and Vegetables	2	2	2
Dairy Products	7	6	6
Meat	6	6	6
Total Food	53	49	49
Household Expenses	9	10	10
Clothing	17	16	16
Total Necessities	79	75	75
Advancement Goods	15	19	19
Recreation	6	6	6
Total Expenses	100	100	100

One further consideration arises in this connection as a result of the contribution to the family living which the farm makes. The food from garden and live stock, firewood from the woodlot and use of the house

TABLE 16—Comparison of the Value of Farm Perquisites on the 33 Forest Area Farms with Those of the 115 Farms Outside the Forest Area, 1942.

	33 Forest Area Farms	115 Farms Outside the Forest Area	All Farms
	$	$	$
Fruit and Vegetables	28	40	37
Dairy Products	48	48	48
Meat	42	39	39
Total Food Perquisites	118	127	124
Firewood	52	63	61
Use of House[1]	57	88	81
Total Perquisites	227	278	266

[1]Five per cent of the value of the house.

are perquisites which add to the level of farm family living. It is conceivable that the lower expenses for food of the forest area farms might have resulted from their use of large amounts of produced food. That this is not so is evident from Table 16, which compares the farm value of the perquisites used by the two groups of families. Most of the total difference comes from the use of the house; the farm homes among the 115 families outside the forest area being of higher value, on the average, than those of the 33 families in the other group. However, even as far as food is concerned, the former used slightly less than did the latter. Hence the smaller quantities of food per family in this group is a result of their lower incomes.

The natural features of the forest area and the ability of the operators of the farms in the area, resulted during the year of the Survey in an average income less than the other 115 farms in the watershed. The average level of living of these 33 families is low and for a good many of the individual farms the level is so low that insufficient necessities are obtained, and almost nothing in the way of advancement and recreation which are considered as part of the Canadian level of living.

CHAPTER THIRTEEN

Land Use and Resources

USUALLY in conservation reports the term land use is applied to agricultural land where it is required to show the different crops which are grown on the land, as well as such areas as woodlots, plantable land, eroded areas and plantations; the last four items being mentioned as occupying so many acres with little elaboration, particularly as regards woodlots and plantations. In this chapter, however, the use of the term is more or less reversed and the four classifications mentioned above have been dealt with in detail, because of their importance from the standpoint of employment. Crop land, on the other hand, is dealt with in gross areas, because work on such land is largely a private enterprise and is elaborated elsewhere in the report.

1. SURVEY TECHNIQUE

[a] Personnel:

The field staff consisted of sixteen field men and one supervisor, all of whom except one are teachers in the schools of the Province. Of the sixteen field men, six were graduates of the Ontario Agricultural College, four were graduates in Science from the University of Toronto, two were graduates of Queen's University, one was a graduate of the University of Western Ontario, one was a teacher of shop work in a collegiate, one was a public school principal, and one a student in the Department of Botany, University of Toronto. The field supervisor was a graduate of Forestry, University of Toronto. In addition to the field staff, there was also the usual camp staff, including a draughtsman, clerk, cook, and handyman.

The camp site chosen was adjacent to the Durham County Forest, four miles from Pontypool on the C.P.R. Field men reported for duty on July 21st and, after a short instructional period, the actual survey commenced on July 30th and ended on September 18th, 1942.

Sleeping accommodation was provided in tents, a wooden structure was used for cook-house and a separate building for an office. Transportation to and from work was done by truck and private car.

In order to acquaint and train the field men in the work to be done, it was necessary to hold an instructional period. Assistance in this was given by members of the staff of the Ontario Department of Agriculture,

the Dominion Department of Agriculture, the University of Toronto, the Forester, and the Chairman of the Interdepartmental Committee. Subjects covered included land appraisal, the elements of surveying, soil identification, tree identification, woodlot management, reforestation and hydrology.

[b] Maps:

The chief reference map used was the topographical map published in 1932 by the Geographical Section of the General Staff, Department of National Defence, drawn to the scale of one inch to the mile and usually referred to as the Military Map. Four sheets of this series are required to cover the watershed, namely Scugog, Rice Lake, Oshawa and Port Hope. These maps show more detail than any other published for the area and, besides giving topographical features such as streams, roads, buildings, woodland, railways, etc., they also give contour lines. They do not, however, give the individual lot lines. A copy of this map was supplied to each field man, and it was particularly useful for general orientation and for reference to property adjoining the specific lots under consideration. The military map, enlarged to a scale of two inches to the mile, was also used as the base map for delineating all data of the survey.

The road map prepared by the Ontario Department of Highways for its own engineers, on a scale of one inch to the mile, was also used. This map was valuable in locating and checking roads. It also gives individual lot lines.

For recording data in the field a special map, known as a cover map, was prepared. This consisted of photographic enlargements of the military map, on a scale of eight inches to the mile. The enlargements were cut into convenient sizes for field use and mounted on stiff cardboard. The data reported on was indicated by symbols on these maps in the field and the different features were coloured as set forth in a schedule. The cover maps were such that they could be built up into a mosaic of a small section of the area, or, if required, of the whole watershed. Together with the reports, they were the source of all information transferred to the base map, which in turn was used for the deductions written into the main report.

[c] Aerial Photographs:

The aerial photographs used while the survey was in progress were supplied by the Department of National Defence and were those taken by the R.C.A.F. during 1927 to 1929, in preparation for the military map published in 1932 and referred to above. These photographs were of special value for checking topographical features on the ground

and for the accurate location of lot lines. However, as most of them were taken fourteen years ago, during which interval the boundaries of the wooded areas changed, they could not be used as an accurate check for such data. Also, during this period many additional forest plantations had been established, which of course do not appear on the photographs.

In September, 1942, a new set of aerial photographs was taken by the Division of Surveys of the Ontario Department of Lands and Forests. These were used for checking data with the cover maps and for delimiting the areas of woodland and plantations.

[d] Field Work:

The land use survey conducted on this project is what is termed a reconnaissance survey. By this is meant a survey which is done more or less rapidly and in which the features studied are reported on under broad classifications, and are indicated on the map in the same way. Such a survey is different from a detailed survey, to the extent that the latter entails the examination of the features studied in detail. Detailed surveys are usually done by experts in the sciences involved; while a reconnaissance survey may be done by less expereinced men, or men specially trained for the work.

For these reasons, therefore, only broad classifications of such features as soils, agricultural land, woodland, etc., were considered in this survey, it being understood that in the preparation of plans for the development of the area, experts in the various sciences involved would make the detailed examination and the final decisions. Moreover, due to war conditions, it was impossible to secure men trained in the sciences concerned to make a detailed survey.

The township lot was used as the unit of measurement and the features reported on in the unit called for an examination of each farm, and each section of the farm. As the work was all done on foot, it meant that practically every acre of the lot was gone over. This rule varied only when the country was sufficiently open and of a uniform character, such as agricultural land and idle land, to permit the viewing of it from a point of vantage.

[e] Criteria for Classifications:

The different main items listed for study, some of which were subdivided where necessary, were as follows: crop land, permanent pasture, plantable land, woodland, forest plantations, streams, springs, ponds, wet spots, flooded land, kettle areas, wells, dams, soils, slope, buildings or remains of buildings, fences, quantity and size of trees in open fields and on old fence lines, road conditions, vegetation and wildlife.

1. CROP LAND:

Crop land was classified on the basis of its present use, such as land planted to crops, fallow land, orchards and land seeded down for hay. In some cases the border-line between crop land and permanent pasture, or even plantable land, was difficult to define. For example, there are many cases on the morainic slope where land was found to have crops of grain a few inches high at harvest time, where the soil was poor gravel, or light sand, with a moderate slope from which the topsoil had been mostly carried away, and which would be difficult to improve so that it could be brought back to worth-while productivity. However, in the instructions to the field men it was clearly pointed out that if there was any doubt as to how such an area should be classified, it should be placed with crop land.

Crop land was divided into three groups, namely: no control needed. moderate control needed, and definite control needed; depending on whether or not some improved methods of tilling, such as plowing on the contour, strip cropping, etc., could be recommended. The criterion for such classification was largely a question of slope.

Crop land on which no control was needed included areas which were level or practically so, and where there was little or no signs of erosion of the topsoil. Land where moderate control was required, included areas where there were definite indications of some washing of the topsoil, slight gullying and wind erosion, but where none of these factors were causing damage to an alarming degree. Areas which required definite control were those where the lots contained a large percentage of hilly or rolling country, which were definitely suffering from small gullies and the removal of the topsoil by sheet erosion, and which could be improved by control measures.

2. PERMANENT PASTURE:

On most large tracts of marginal and submarginal land, it is possible to find areas which could be used for permanent or community pastures. Such areas are those in which the soil value, combined usually with steepness of slope, is such as to make a continuous rotation of field crops impractical. The presence or non-presence of water, such as springs, streams, or the possibility of wells, is another deciding factor. Such areas might be developed as permanent pastures, although most of these found on the Ganaraska come rather close to being plantable land. When, however, the indications warranted it, such land was classed as permanent pasture.

3. PLANTABLE LAND:

Plantable land was defined as those areas which should be segregated from crop land and transferred to the permanent growing of trees.

Such areas included land which had been abandoned from the standpoint of agriculture, treeless grass covered plains, cut over pinelands, and severely eroded areas. All of these for the most part consisted of light or gravelly soil, and steep hillsides of heavier soils which were eroding badly.

Plantable land was divided into four classes, namely: stabilized, sheet erosion, gully erosion, and wind erosion. Stabilized land included such areas as grass land, or abandoned farm land, on which there were few, if any, trees, and on which the turf for the most part was intact. Sheet erosion included areas of the same kind which showed signs of top washing, including rills, which were not severe enough to be classified as gullies. Gully erosion included areas which contained gullies of different sizes. Wind erosion included areas where the turf had broken down and the field was definitely becoming a blow sand area.

4. WOODLAND:

Woodland was classified in the broadest use of the term. It included areas on which there were well-stocked and mature stands of many species down through a list of conditions to one in which the area had recently been cut over and nothing but stumps and slash, with some young growth, remained. This latter condition, while not measuring up to the standards of a woodlot as judged for practical purposes, is nevertheless, in its biological sense, a potential woodlot and therefore rightly belongs in this classification. Where an area of woodland was less than half an acre in size, it was not recorded as such, but indicated as a grove.

5. SOILS:

Soils were reported on under a broad classification, namely: sand, gravel, loam, clay, thin soils with a rocky subsoil, and stony areas, the last designation being combined usually with other classifications. It was considered that such a classification would meet the requirements of the reconnaissance survey, as a detailed survey of soils was being made by soil experts (see chapter ten).

6. SLOPE:

The schedule for slopes was the same as that adopted by the Provincial and Dominion Soil and Soil Conservation Surveys, namely: 0 to 3% level to nearly level; 3 to 8% undulating; 8 to 15% rolling; 15 to 25% hilly; 25 to 35% very hilly; 35% or more, steep.

7. KETTLE AREAS:

On the morainic upland, which forms the height of land separating the headwaters of streams and rivers of this area which flow in several

directions and sometimes referred to in geological literature as a "knob and kettle area", there are depressions caused by glacial action which are known geologically as "kettles" (sometimes called "pot-holes"), the name being suggested, no doubt, by the shape of the old-fashioned potash or syrup kettle. These areas, of course, vary in size from an acre or so to several hundred acres. Kettles hold snow-water in the spring and some of the larger ones, notably the ponds at Pontypool, retain water throughout the whole year. These formations are important from the standpoint of collecting water for deep seepage into the morainic upland. All such areas, so far as was possible, were indicated.

8. VEGETATION:

The compiling of a complete check list of all vegetation on the area was not possible in the time allotted. An attempt was made, however, to list all tree species on the area and small woody plants, such as shrubs and other low growing plants with woody stems, as well as a few of the common grasses.

9. WILDLIFE:

This included the reporting of birds, fish and the common game and fur bearing animals such as fox, rabbit, mink, etc., and was intended to cover conditions as they were at different stages of the watershed's history, as well as the present.

10. OPEN GROWN TREES:

Trees on old fence lines and in open fields were recorded only where they occur on plantable land. Such trees are an encumbrance on the land in the event of a reforestation scheme and would have to be removed.

11. OTHER ITEMS:

All other items indicated on the schedule—namely, forest plantations, streams, springs, ponds, wet spots, flooded land, wells, dams, buildings or remains of buildings, fences, and road conditions—require no special elaboration.

[f] Reports:

All data recorded on each lot was indicated by symbols and colours on the cover map. In addition, a report known as the "cover map report" was made out for each lot on which all items were referred to by symbols and were reported on in writing, depending on the amount of information available on each, and the judgment of the field man. Therefore, by using the cover map and the cover map report, supplemented by special reports to be described presently, a complete land pattern and coverage was obtained for future reference.

Special reports were used for features such as woodland, plantations, wildlife, streams and ponds. For these, definite information was required in each case which could not be left to the judgment of the field man. In addition, a general property report was made out—partly in the field and partly in the office.

[g] Methods used in Reporting Data:

Crop land was reported on by observation and checked by pacing and the use of the Abney level where necessary for slopes. Plantable land was done in the same way, except that special mention and approximate size was given for erosion areas. Groves were indicated as to size, together with species and height. Springs were indicated as to size and flow; and permanent ponds, wet spots and flooded land, as to size and extent. Kettle areas were recorded as to size; wells as to depth and type of curb; dams were located as to position and size, construction and former use. Buildings were indicated as to size and type. Fences were stated to be poor, fair, or good, depending on their ability to exclude cattle. Quantity of trees on fence lines was stated as to number, height and species. Reports on roads had to do only with changes in location, new roads not shown on the maps, or roads which had been closed for one reason or another. Soils were examined by using a garden trowel.

The property report was used to show a few of the most prominent features of the property, in brief manner, in order that the lot could be quickly appraised in the office.

The woodland report was used for any area a half an acre or more in size, on which 25 per cent of the area was covered with trees. Also, wooded areas which were sufficiently large to contain two or more different types were treated as different areas and separate reports were made out for each. The percentage of species on the area was arrived at by laying off a circle with a light rope, equal to one-sixteenth of an acre, in which all trees ten feet high or more were counted. These figures then multiplied by sixteen gave the number of species per acre. Before the one-sixteenth of an acre was measured, the woodlot was examined thoroughly in order to locate a representative area for measurement; and in large woodlots two or more measurements were taken. Under type was indicated whether or not the woodland was composed of all hardwoods, all conifers, or a mixture of both. Height was estimated. Insects and disease were recorded only where there was evidence of large areas being attacked. Seedling and young growth was estimated on the basis of one-sixteenth of an acre. The need of planting was based on open places in the stand, supported by the young growth count.

Other items recorded were: the amount of cutting in the woodlot, and whether or not this had been done in a systematic way, or just a

hit and miss fashion; improvements such as systematic thinnings, clearings, etc., and notes on grazing and fire damage.

The procedure with forest plantations was much the same as for woodlots, although not so extensive. After the planting arrangement, which included spacing, was noted, it was a simple matter to compute the number per acre.

Wildlife reports, for obvious reasons, were not recorded for each property. Periodically, or whenever the occasion was favourable, a resident in the neighbourhood was contacted, and in this way, together with observation in the field, the reports were made out. In like manner, much of the information on the report for streams and ponds was compiled.

2. GENERAL LAND USE

[a] Crop land:

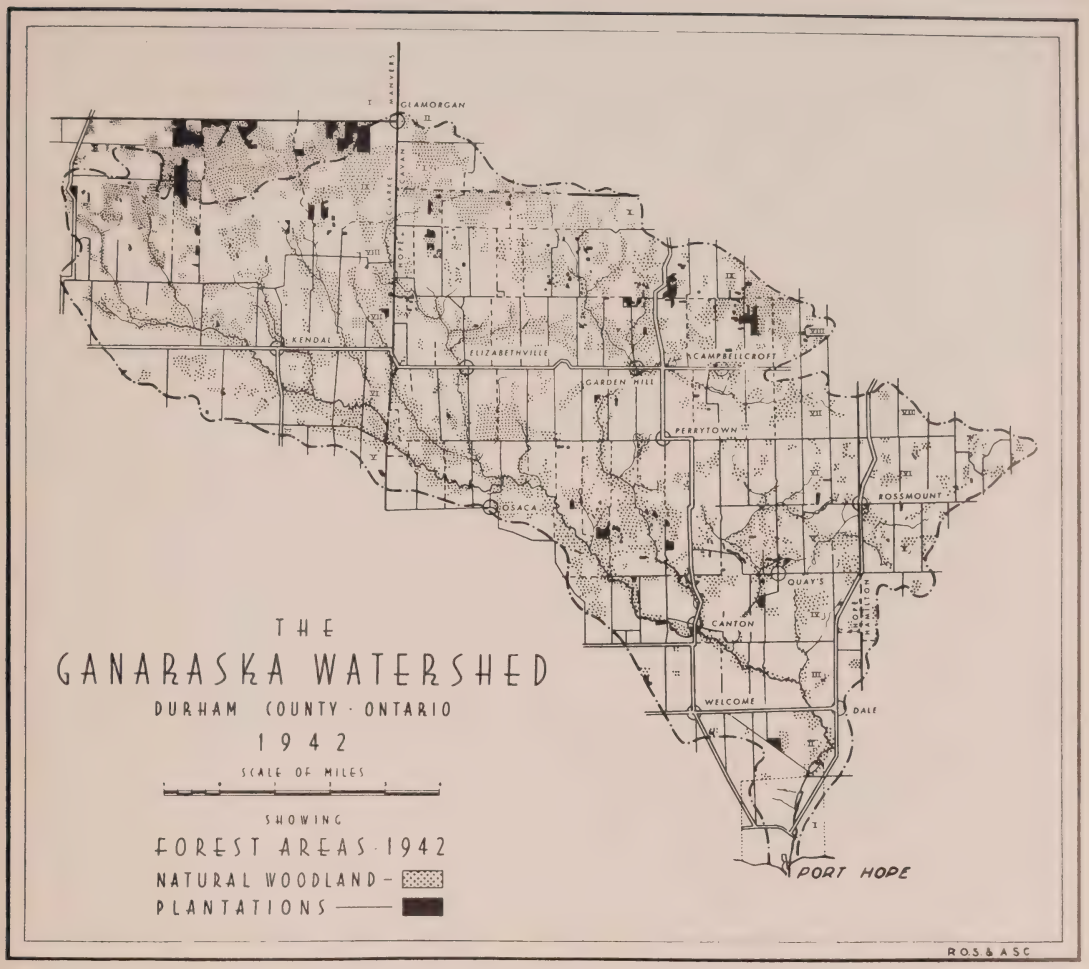
Of the total land surface of the watershed, namely 65,911 acres, a little more than one half, or 33,672 acres, has been classified as crop land. However, from the standpoint of good agricultural land this figure is a trifle high because the benefit of the doubt was always given to crop land, over plantable land.

In delimiting crop land on the watershed, three general classifications were made, namely: areas on which no control from the standpoint of soil erosion was needed; areas where moderate control was required; and those on which definite control was urgent. While such classifications are on record, they will not be elaborated here as the control required is beyond the scope of this chapter. Such recommendations would have to be made by a soil conservation specialist on the individual farm, in the presence of the owner.

[b] Woodland:

Land use, under this heading, represents 15,361 acres of the whole area, or a little less than one half the total agricultural land, and only 1,516 acres less than the combined area occupied by plantable land, eroded areas, plantations and towns. The total number of individual woodlots examined was 718, which includes a small percentage of areas which are considered by their owners as constituting a single woodlot but which, because of the difference in types and age classes of certain sections of the woodlot, had to be considered in the field as separate units.

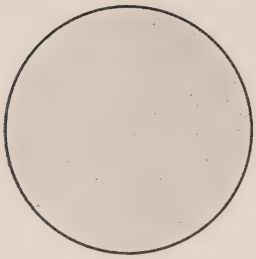
While the upper part of the watershed originally showed a preponderance of conifers, with a high percentage of pine, during the time since heavy logging operations occurred, the percentage of hardwoods has increased. The result is that at present, of the 718 woodlots exam-



ined 28.2% are classed as pure hardwoods, 16.3% as pure conifers, and 55.5% as mixed stands.

For the whole area the percentage of uneven-aged stands is slightly more than even-aged, the difference being 59.6% of the former, and 40.4% of the latter. This preponderance of uneven aged stands is due to the larger percentage of woodlots in the more southerly or better agricultural section of the watershed, forming an important part of the farm economy, in contrast to the clean-cutting methods which are more common on the northern parts of the watershed.

Grazing in farm woodlots shows a high percentage for the entire area, being 75.6%, which is an indication of the low value which the average land owner places on his woodlot as a permanent crop. Grazing, as is well known, is detrimental to the proper development of any wooded



LAND USE,
TOTAL
WATERSHED
65,911 acres
(100%)

CROPLAND
33,673 acres
(51.08%)

WOODLAND
15,361 acres
(23.31%)

PLANTABLE
LAND
11,988 acres
(18.19%)

EROSION
2,126 acres
(3,23%)

PLANTATIONS
1,668 acres
(2,53%)

TOWNS
1,095 acres
(1.66%)

area. The number of cattle and the size of the woodlot have a direct relationship to the damage which might or might not be done. For example, a large woodlot would not be seriously affected by a few head of cattle, whereas a small woodlot, which is usually the case on better farms can be seriously damaged by a large herd. Grazing in a woodlot destroys young growth; open areas appear and become covered with grass, which means that the maintenance of the forest floor, which is so important to the health of the stand, is interfered with, and there is less likelihood of a renewing of the stand by reseeding from older trees. These in turn become stag-headed and are easily preyed upon by fungus and disease.

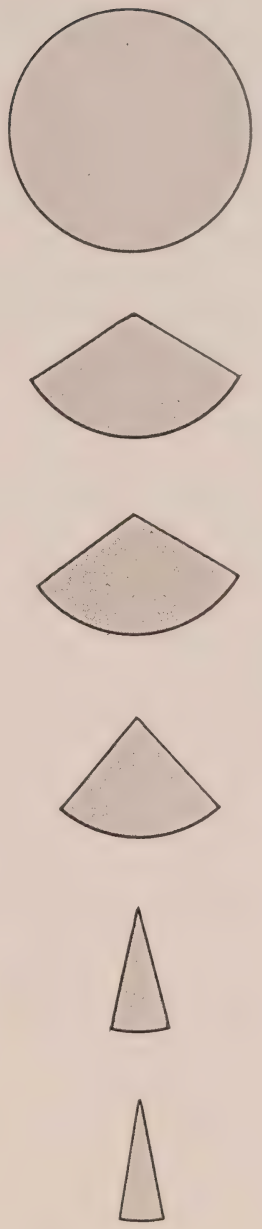
The burning of woodlots on the area in recent years is practically negligible and indications of this were recorded on only a few lots, which placed the percentage for the area at .9%. Even in the more northerly unsettled parts of the watershed, few disastrous fires have occurred in recent years. However, old residents still recall extensive fires which occurred thirty or forty years ago, on areas which had been recently logged, and where the brush and old tops provided a severe fire hazard. One of these fires occurred in the early '90's in the region of Lot 22, Concession 1, Manvers Township, and burned for several

days before the people of the community could bring it under control.

Due to the prevalent practice of grazing in the woodlots, many of the stands have become open and require some planting. Of the number examined, 72.5% require planting of some kind to bring them back to a fully stocked stand.

Cutting in woodlots and clean-cutting of whole areas has been carried on persistently in recent years; many acres being sold for cordword and other areas, where white pine is found, being cut into sawlogs of small sizes. However, taken over the whole watershed, such cutting is not as extensive as one might expect in such a wooded area, as on examination it was found that 15.2% of the woodlots has been more or less severely thinned, while 12.4% has been exploited or clean-cut, thereby reducing the woodlot to slash and young growth.

Percentage of mixtures and distribution of species is dealt with in detail in the section on vegetation. However, as would be expected and as is the general rule throughout southern Ontario, pine and other conifers, either in pure stands or mixed with hardwoods, occupy the sandy and gravelly areas; mixed hardwoods occupy the better land and the slopes of the ravines; while cedar, elm, soft maple, basswood, yellow birch, and othes species preferring wet land are found along the creeks and bottom lands.



The woodland in general is characterized by young stands, most of which range from 30 to 50 feet in height, with smaller areas of less height and a few areas containing trees up to 80 and 90 feet in height. The few lots containing the largest trees are composed of pine and hemlock and some old hardwoods, and some of these areas are of exceptional value. In one woodlot examined, pine was being cut for a special purpose, which measured 80 feet in length on the ground ready for delivery.

From the foregoing it will be seen that while the wooded areas on the watershed are extensive, there has been no systematic method followed in improving these over the whole area, and very little consideration is given to the exclusion of cattle.

[c] Plantable Land:

Under this classification was placed all land of the open or grass-land type, which was not being regularly cropped and which was considered of such low soil value as to be unfit for cropping. Some of the land placed in this class, especially in the lower part of the watershed, on further examination might be considered, by an agronomist, as useful for permanent pasture. Of the total area on the watershed, 11,988 acres were considered suitable for planting, to which should be added 2,126 acres which were classified as erosion. These two figures account for approximately one-fifth of the land area of the watershed. It should be pointed out, however, that over one-half of this acreage is found on the proposed Ganaraska Forest, which is an indication of the extensive areas of poor soil found in that region.

Many of these grass-land areas, especially in the north, are unfenced and are covered with wild grass which affords some pasture in the spring, but especially in dry years, in midsummer, pasture is very scant. Abandoned farm buildings and old homestead sites dot the area here and there, testifying to the struggle which was exerted by the former owners on land which is intrinsically too poor for successful agriculture.

In the southern part of the watershed, the areas of this class are widely acattered, most of them occupying odd corners of farms, with an occasional large area of 50 or 100 acres where the poor soil comes to the surface.

[d] Eroded Land:

By this is meant areas from which the protective covering of vegetation has been removed by water on gentle slopes, by wind on fine sandy areas, and by excessive washing in gullies and steep slopes. Most of this class of land is found on the brow of the moraine, within

the proposed forest area, where the high land breaks sharply over the slope. Conditions for erosion of all three classes are ideal along the face of the ridge, due not only to the steep gradient, but also to the loose texture of the soil. Of the total area of this class of land on the watershed, namely 2,126 acres, the area occupied by the proposed forest contains 1,426 acres, while 700 acres are found scattered throughout farming sections in the south.

[e] Forest Plantations:

The cheap light land on the morainic upland and the steep parts of the slope have been a fruitful area for tree planting. Of the 1,668 acres of plantations on the watershed, 1,089 acres are found in the proposed Ganaraska Forest, and most of these form a part of the Durham Forest, which is owned by the United Counties of Northumberland and Durham.

Of the total area of plantations, 475 acres are less than 10 feet in height, 797 are 10 to 14 feet in height, and 396 acres are over 15 feet. The predominating species in these are Scotch pine, found in 103 plantations; red and white pine, in 73 plantations; jack pine, in 69 plantations; white spruce in 31; hardwoods of different species in 34; and a few plantations contain Norway spruce, cedar and hemlock. It should be pointed out that the above numbers of species do not represent the percentage of each species used in the area, but simply indicate the choice of individuals for certain species. Time did not permit of making an accurate count of all species in each plantation.

SUMMARY OF LAND AREAS IN ACRES

	Crop land	Wood-land	Plant-able	Ero-sion	Plan-tation	Towns	Totals
Ganaraska Forest.	4,572	6,249	6,497	1,426	1,089	.....	19,833
River Fringe.....	6,642	7,862	2,805	394	409	.....	18,112
Remainder of Watershed.....	22,459	1,250	2,686	306	170	1,095	27,966
Totals for Watershed.....	33,673	15,361	11,988	2,126	1,668	1,095	65,911

CHAPTER FOURTEEN

Vegetation, Forest Insects, Diseases and Fish

1. VEGETATION

WHEN the Ganaraska Survey was planned, a study of the vegetation so far as time would permit, was included. A complete plant survey, however, was obviously out of the question as the period included only three of the summer months. It was decided, under the circumstances, that a collection of the woody plants, including trees, shrubs and climbers, of a part of the area could be made, and it was felt that this would contribute to the knowledge of the vegetation of the area.

[a] Trees and Woody Plants:

The representative part of the watershed chosen was an area extending from lot 8 to lot 19 in concessions VII to X in Clarke Township and in view of the nature of the survey, and especially the fact that time was not available for revisiting areas during the season, the list of woody plants cannot be considered complete. (See appendix for this list).

The method of surveying did not lend itself to intensive study in ecolological habitats. However, the individual woodlots of each township lot were examined thoroughly and some generalizations regarding the occurrence and distribution of forest trees can be made. Species counts were made, employing the 1-16th acre circular quadrate method and the number of each species of forest tree per acre was recorded for individual woodlots. These figures present a general picture of species distribution and indicate the interesting change in species as one proceeds southward from the dry sand-gravel ridge. Concession X lies wholly on the ridge and Concession IX represents an area of transition between the ridge and the lower, less gravelly soils of Concessions VIII and VII, hence the change in species is well illustrated by averaging the counts of each species for all the woodlots in each separate concession. This includes only the area of land outlined previously.

The data in the following table are averages; for example, 244 red oak trees represent an average density of this species for all the woodlots examined in Concession X. This method of arriving at a general picture of species distribution has its limitations because of the great diversity of woodlot size.

In addition, the species counts do not take into account the comparatively recent removal of most of the white pine from certain woodlots. This latter error could be obviated if time were available for the examination of stumps. In spite of these limitations, the data confirm the observations of the field men who did the land use survey, and are the only data on hand to illustrate this point.

TABLE 1—The Distribution of the Main Forest Tree Species.

Species	Average Number per Acre			
	Concess. X (12 woodlots)	Concess. IX (22 woodlots)	Concess. VIII (20 woodlots)	Concess. VII (21 woodlots)
Red Oak	244	212	22	4
Poplar	71	129	15	11
White Pine	49	36	50	6
Sugar Maple	28	72	108	93
White Birch	52	81	17	22
Red Maple	9	28	11	13
Hickory	54	41	5	...
Black Cherry	6	29	5	1
Ironwood	9	21	68	17
Beech	4	8	20	8
Basswood	...	3	18	11
White Ash	...	2	4	4
Black Ash	...	...	3	7
White Cedar	...	...	52	372
Yellow Birch	...	...	25	52
Hemlock	...	...	15	52
Elm	...	...	11	16
Larch	...	...	...	2

[b] Analysis of the Data in Table 1.

The Ganaraska Watershed lies within the Southern Mixed Forest part of the Eastern Coniferous Forest of Canada, the so-called *Pinus-Tsuga* Formation. *Pinus strobus* (white pine) was a dominant species in the area, often forming consociations in regions of lighter soil. The numerous pine stumps being used as fences or even remaining in fields on the ridge are evidence of this. Only a few scattered pine-hemlock woodlots have escaped the ravages of axe or fire. White pine regeneration is observed to some extent in most of the deciduous woodlots which have become established since the cutting or burning of the original climax forest, and in some it is a prominent feature.

In the dry sand-gravel soil of the ridge, red oak is at present the most abundant species, averaging 244 trees per acre in Concession X. Associated with it are other species including bitternut hickory, white birch, white pine and poplar. Poplar species are particularly prominent on the ridge where considerable cutting of the present deciduous forest has taken place.

In Concession IX, in what has been referred to as the transition zone, red oak is still the prominent species and poplar and birch have increased considerably. The most notable change is the increase in sugar maple from 28 per acre in Concession X to 72 per acre in Concession IX and a corresponding increase in species usually associated with it, such as black cherry, red maple, ironwood, and to some extent beech.

Proceeding farther south to Concession VIII sugar maple becomes the most abundant species with considerable white pine, ironwood, some beech and basswood. Cedar and yellow birch are plentiful in the moist woodlands along the small streams. In these richer, moister soils where sugar maple is plentiful, red oak, poplar and birch are a much less important constituent of the vegetation.

Referring to the map, it is evident that in Concession VII the main woodland areas are adjacent to streams. Many are quite moist, being flooded in springtime, and others are more or less swampy throughout the summer. Hence one would expect a preponderance of moisture-loving or moisture-tolerating species. From Table 1 it is seen that cedar has become dominant with yellow birch and hemlock occurring frequently. Sugar maple is still the most abundant species in the highland woods of Concession VII. The extremely high cedar count is a direct result of frequencies up to 1,000 trees per acre found in small swampy woodlots. Since, in averaging, these are given as much consideration as a large highland wood, the list gives the cedar more prominence than is strictly justified.

No collecting was done in the area south and east of the part of Concession VII concerned in this report, but it is known that further changes occur. White oak and silver maple, for example, species which never were encountered in the area referred to above, are found here in considerable numbers. Elm species, especially the American elm, are more common than in the area to the north.

[c] Observations on Grassland:

Many fields which formerly were cultivated and have been abandoned for a number of years have become colonized by herbaceous vegetation and are now almost purely grassland. The following are the main species of grasses: Kentucky bluegrass—*Poapratensis L.* Canada bluegrass—*Poa compressa L.* Red top—*agrostis alba L.* wild oat grass—*Danthonia.*

Although Kentucky bluegrass is the most common natural grass, it fails to colonize the dry gravelly knolls and hilltops. Instead, Canada bluegrass, a less dense sod-former, is found in such habitats. Frequently a definite line can be found on hillsides where these two species meet. An interesting observation in this connection leads one to believe that the above condition is correlated with the beginnings of erosion. Both the bluegrasses are early flowering, non drought resistant species. However, after flowering or during the flowering period the stems of Canada blue grass remain comparatively green and as a result are much more palatable than the dry stems and leaves of Kentucky bluegrass. Consequently the grazing animals crop these exposed sites exceedingly closely and the short remaining parts of the plants are soon dried up in hot dry weather. Canada bluegrass is not a dense sod former, especially on these droughty soils of the ridge, and frequently one observes places where the grass plants have been killed, and the dead plants blown away. Thus the soil is left exposed to the forces of erosion. The wind sweeps away the small loose soil particles and the rains wash the harder portions, causing sheet and gully erosion. The beginnings of erosion apparently caused in the above manner are observed more frequently on southwestern exposures, suggesting that the heat of the sun during dry weather plays an important part in the succession of events leading to erosion in such rolling grassland areas.

[d] Suggestions for Future Work:

When planning reclamation projects in Ontario one inevitably thinks of pine reforestation. There are large areas where this is clearly the procedure that should be adopted. It is pertinent to suggest, however, that while this is being done, intensive work should be carried on by trained ecologists to ascertain precisely what effects such procedure has, over a period of years, on the soil and flora under Ontario conditions. Studies of this kind, along with equally important investigations with other woody and herbaceous forms, are important if we are to avoid costly mistakes in dealing with doubtful areas, and even with some areas about which, in our present state of knowledge, there seems little doubt as to the proper procedure.

In this connection lessons can be learned from the experience of conservationists in the United States. As a result of their researches in erosion control it has been found preferable over large areas to make use of herbaceous plants whose soil-holding and humus-building properties have been ascertained. In this way they have been able to produce most excellent results in a minimum of time and with enormous financial savings.

In probably the majority of cases the plants they have found most useful would not serve at all under our somewhat different conditions of environment. It would be necessary, therefore, to undertake some serious work with a view to discovering and testing the plants that will best serve for the reclamation of our region. The Ganaraska region, with its variety of soil and ground cover, would lend itself admirably to such investigations, and with it as a headquarters discoveries would be made, applicable to other regions of the province.

2. FOREST INSECTS

Two surveys[1] of forest insect conditions within the Ganaraska Watershed covering the main insect periods were conducted June 21-25 and August 10-14. In carrying out the surveys, collecting stations, representative of the forest types and sites within the area were established, and the insect population of each species of tree was sampled by standard methods. In addition, observations were made at numerous intermediate points in an effort to determine the distribution of insect populations as accurately as possible. Particular search was made for the presence of insect species that are capable of causing serious damage to forests or are known to interfere seriously with the establishment of new plantations. Insect determinations were made by the Forest Insect Laboratory, Ottawa.

While the survey did not reveal any insects present in serious outbreak form, a number of species were noted that are very definitely of economic importance and are apt to cause trouble.

The white pine weevil, *Pissodes strobi Peck*, is distributed throughout the watershed. However, very little injury was noted on young white pines growing under hardwoods and only moderate injury to those planted mixed with red pine.

The European spruce sawfly, *Gilpinia hercyniae* Htg.; Leconte's sawfly, *Neodiprion Lecontei* Fitch; and the nursery pine sawfly *Gilpinia frutetorum* Htg.; although in relatively small numbers, may be a serious menace to future developments and should be watched with special care.

An infestation of the European pine shoot moth, *Rhyacionia buoliana* Schiff., on mugho pine near the southern tip of the watershed will definitely constitute a serious threat to young plantations of red pine, Scotch pine, mugho pine and Austrian pine.

Larches growing on low ground, especially in the eastern area of the watershed and beyond, have been seriously defoliated by the larch casebearer, *Coleophora laricella* Hbn.

[1]These surveys were made in 1943.

The pine spittle bug, *Aphrophora parallela* Say, was very prevalent on pine, spruce, and larch. Scotch pine in plantations has at times suffered heavy mortality.

The hemlock looper, *Ellopia fiscellaria* Guen., was found present on most hemlock sampled. This insect can be very destructive over large areas.

The following important insects, found present, frequently cause severe defoliation to deciduous trees:

The linden looper, *Erannis tiliaria* Harr., defoliated basswood, elm, ironwood, alder and other hardwoods throughout the area.

The walkingstick insect, *Diapheromera femorata* Say, was very abundant in the area. This insect will undoubtedly be responsible for considerable defoliation of many hardwoods from time to time.

A light infestation of the palmer worm, *Dichomeris ligulella* Hbn., on red and white oaks was noted. Young oaks in plantations are frequently severely injured by this insect.

Light infestations of the fall webworm, *Hyphantria textor* Harr., were observed on hedge and roadside trees.

Other insects found present, that occasionally cause serious injury, though frequently only to relatively small numbers of trees, are listed in the Appendix.

In any project, such as proposed for the Ganaraska watershed, careful consideration should be given to the prevention of insect outbreaks and adequate arrangements made for the immediate application of control measures when these become necessary. While it is not possible to predict accurately the course insects may take under the ever-changing conditions of a newly reforested area, there are a number of fundamental principles which, if applied, will greatly lessen their destructiveness.

It is important to avoid the planting of large areas to one kind of tree, otherwise conditions will be ideal for an outbreak of abnormal numbers of some insects which prefer the food afforded by that particular host. It is preferable to plant in blocs, the blocs distributed so that trees of one species are separated by blocs of different tree species. This tends to keep outbreaks localized until natural agencies bring them under control and facilitates direct control measures if such become necessary.

It is important to plant only the species of trees suitable to the site and existing growing conditions. Healthy, vigorous trees are certainly more resistant to insect attack than weak, struggling ones.

Over-mature and dead trees should be removed from the existing stands as these harbour bark-beetles and wood-boring insects, which may become excessively abundant and attack healthy adjacent trees.

Care should be exercised to prevent ground fires. Even light ground fires are frequently followed by severe outbreaks of bark-beetles and wood-boring insects.

Woodcutting operations, sawmill sites and wood storage yards should be carefully supervised or they may become reservoirs of infestations.

It is essential that surveys for insect conditions be made each year so that any abnormal increase in insect populations may be noted and control operations initiated before they develop to outbreak proportions. Serious and widespread outbreaks are frequently prevented by prompt and well-timed spraying operations over a comparatively small area. It is therefore necessary that spraying equipment be available and that laneways be maintained within the plantations for spraying purposes. Outbreaks of an extensive nature can generally be brought under effective control by strip spraying. In this method, alternate strips of trees in large plantations are sprayed, thus reducing the initial infestation and at the same time causing the native parasites to concentrate and build up in the unsprayed portions. This reduces spraying operations and the number of lanes for the passage of spraying equipment.

Owing to the danger of injury by the white pine weevil, white pine should not be planted in pure stands unless the stands are very densely stocked in a good site. It is better to grow white pine in mixture with some immune species, such as the better hardwoods. The protecting species should be taller than the white pine, at least in the early years.

In conclusion, it should be recognized that protection against leaf-feeding insects is very desirable since defoliation of a tree weakens it and thus makes it more susceptible to attack by bark-beetles and wood-boring insects as well as by organisms which do not usually attack healthy trees but which will hasten the death of weakened trees. Leaf-feeding insects alone may kill a thrifty, broad-leaved deciduous tree by completely defoliating it for three years in succession. Conifers, however, are usually killed as a result of one complete defoliation.

3. TREE DISEASES

[a] Introduction:

Productive woodlands require protection against fire, trespass, grazing animals and rodents, insects and disease. Protection is a part of forest management, and under a policy of sustained yield will be main-

tained in continuity. Good forest management is reflected in the health of the woods and, conversely, damage on account of disease is often a sign of mismanagement or neglect. In general, an objective of maximum yield, with attendant intensive silviculture, is compatible with, and often facilitates protection and disease control.

For the purpose of discussing their pathology and protection, the hardwoods may be considered separately from pine in natural stands or plantations. The chief diseases of the hardwoods are the various trunk, butt and root rots, and chronic stem cankers, which are all endemic, and may cause serious damage under aggravating conditions. Woodlots on the Ganaraska Watershed present very diverse conditions with respect to the incidence of these diseases, a circumstance which is usually related to their past history. Thus many containing old timber are in need of heavy preliminary salvage and sanitation cuttings, as a result of mismanagement or neglect. Such cuttings should precede or be combined with cleanings and improvement cuttings, designed to improve the composition and structure of the stands. Having established a sanitary condition, normal care should maintain it, and obviate loss on account of decay.

The wood rots are commonly thought of as diseases of mature and over-mature timber, but experience has shown that infection may occur at a very early age. Thus in hardwood sprouts, the stem may be infected from the parent stump. In older trees, infection is chiefly through wounds, either of the root or trunk, which may be caused by fire, trampling by animals, insects, meteorological agencies, or by carelessness or accident in felling and other woods operations.

Hardwoods are commonly cut selectively and not infrequently in clear fellings. Few foresters will approve the latter system, which in fact is often intended as a liquidation of the property. A system based on yearly selection, or frequent periodic return to conveniently planned subdivisions, has obvious advantages for small woods, and is well adapted to the control of decay.

For many reasons "cleanings" in the reproduction are desirable, especially where the woods have been heavily cut. While favouring the valuable species, those sprouts which, on account of decay hazard are of undesirable origin, should be eliminated. Such will comprise sprouts from the larger stumps, and those from above-ground position.

In harvest cuttings, which should recur at frequent intervals, the permissible volume allotted should include trees in which incipient decay is discovered, and so far as possible, those which have become a poor risk through injury or other circumstance.

White pine is found in young plantations, and in natural stands,

almost pure, or mixed with hardwoods. From the latter stands it tends to disappear, on account of hardwood competition, except on sites which are particularly favourable for its reproduction. The white pine blister rust, which, with the well known shoot weevil, is a principal enemy of the species, is a factor contributing towards the elimination of seedlings and young trees. If it is desired to retain the white pine permanently as a stand component, special blister rust protection is required, which will involve the elimination of cultivated black currants from the neighbourhood, and periodic eradication of wild *Ribes* in the immediate vicinity of the stand.

White pine should be encouraged on those sites which are naturally suited to its reproduction, so that fairly compact growth may be secured, thereby facilitating the protection problem. It is an important and valuable species in southern Ontario, and its cultivation should be promoted by the institution of effective blister rust control facilities.

[b] General Topographical and Forest Conditions:

The topographical and forest conditions within the basin of the Ganaraska have been described elsewhere, but may be recapitulated here for the purpose in hand: Two general regions may be recognized, each more or less distinct topographically and silvically. The first comprises the lower parts of the watershed, where the land is generally more fertile than above. Here tolerant hardwoods tend to characterize the woods, except on isolated areas of very light soil, and in swampy situations. Here, too, there is a representation of mature forest conditions. The second region comprises the headwaters area, which is generally poorer, of lighter and less fertile soils, and with generally inferior woods, poplar, birch, oak, etc., with white pine as a more or less important component. The stands here are mostly quite young, and the types represented are probably temporary or transitional.

The salient feature distinguishing silvical conditions in the two regions is the relative importance of white pine in each. Although white pine was undoubtedly once abundant locally in the lower region, it has on the whole failed to maintain itself well in the remaining woods under the conditions of exploitation in effect there, and has given way to hardwoods. An exception may be noted in the case of certain pine-oak stands, but in many woods pine could be re-established only through planting. In the headwaters region, in spite of severe exploitation, pine has maintained itself successfully in some of the existing woods, and can be found increasing and improving its position.

Most of the mature hardwood is in woodlots operated more or less on the selection system. This is especially true of the mesophytic sites. On wet bottom lands, mature even-aged elm and soft maple stands are

seen, which represent a conversion from cedar swamp. Second growth mixed hardwoods (pole sized material and smaller) are often found, however, in even-aged stands which have been brought to that condition through cultural treatment. Oak occurs in hardwood and mixed pine-hardwood stands, and as a component of pine-oak stands, of which there is quite a large representation in young growth stages, especially in the headwaters region.

The woodlots examined are classified in the following cover types:

1.—Poplar-birch
White pine-oak
White pine (old field type)
2—Pine-mixed hardwoods
Tolerant hardwoods
Hemlock-hardwoods
Hemlock
3—Soft maple (bottom)
Poplar-elm (bottom)
Elm-cedar (bottom)
4—Cedar swamp
5—Willow (flood plain)

[c] Pathological Conditions:

The report on pathological conditions is made on the basis of observation in the month of November in twenty-eight woodlots, which were chiefly representative of the more productive (mesophytic) sites and older stands. Some special attention was given to young pine and pine-oak mixtures.

1. HARDWOODS

Mature timber. As already noted, the old timber is chiefly in selection stands. The history of their treatment seems generally to have been the periodic selection of the best and most readily accessible trees of convenient size, and the leaving of the largest and more defective trees, with concurrent neglect of young growth of all sizes. The amount of overmature elm, maple, basswood, beech, etc., in some woodlots was truly surprising. Often, though the volume of large sized material was not excessive, it was depreciating through decay.

The chief types of damage observed in the woods comprised the following:

Windthrow: Old uprooted trees, usually more or less defective, apparently left to rot.

Windbreakage: Trees, usually badly decayed, broken above the stump, often in mid-trunk.

Windbreakage in the crown: Trees of large size with large limbs torn from the crown. Particularly common in elm, and probably indicative of top rot.

Lightning scars: Some of the largest trees seen were badly scarred by lightning stroke.

Chronic stem canker: These cankers originate at a comparatively early age, and persist in the cambium region, causing target-type and similar cankers, which result finally in severe deformation of the trunk, and sometimes death of the tree. Such cankers were fairly common in old beech and maple, and affected trees were apparently left in the woods on account of their relatively low value.

A large amount of decay was indicated in the old trees of mature stands. There are characteristic rots of the various species, Thus basswood is commonly hollow from the base upwards. Elm is frequently subject to rot in the upper part of the trunk and in the heavy branches of the crown. Continued selection for felling of the best trees accumulates decayed timber in the stand, and perpetuates unsanitary conditions resulting in infection of young timber before it matures. An abundance of fructifications of the common wood-rotting fungi in most of the woodlots indicated that conditions were highly unsatisfactory there from the standpoint of health.

Young growth: Young growth occurs in the selection stands and in even-aged stands. As explained above, the young growth in selection stands containing old, defective timber is subject to a high risk of infection from wood-rotting and canker-forming fungi, and in general the young growth in selection stands was in poorer condition than that in even-aged stands. From the standpoint of health, the chief defects in the young hardwood growth were associated with unsanitary conditions in the woods and, lack of intelligent cultural treatment. Specific defect and damage was noted as follows:

Incipient chronic stem cankers, especially in young maple and beech, apparently originating at branch bases, in small trees. These stems should be removed in thinnings.

Low forking in young hard maple, which will either persist to maturity, or cause a large stub-hole in the trunk, with almost certain rot. The cause of this common forking was not determined. Many such trees could be eliminated in improvement cuttings.

Low, wide spreading crowns, especially in red oak, in oak and pine mixtures. These trees develop large trunk cavities and rot, as a result of the death and decay of large lower branches coincident with the closing in of the stand. Appropriate cleanings of the stand in early life can obviate this condition.

Hardwood stump sprouts—especially of red oak: These are commonly undesirable, being subject to butt rott, when from large stumps,

or from above ground position. Their large crowns, besides interfering with other trees, predispose them to decay in later life.

Hypoxylon canker in poplar: At several localities in the headwaters area, the poplars (*Populus grandidentata* and *P. tremuloides*) were suffering severely from this canker disease.

2. PINE:

Mature timber. No real old-growth pine was seen, but mature and semi-mature timber was found in mixture with hardwoods, in open grown (old field) stands, and in the pine-oak type. In the latter, pine was reproducing itself successfully, the forest assuming a shelter-wood form.

There was little evidence of damage on account of disease in mature pine. Red rot (*Trametes pini* rot) was detected in several stands, and may be expected to occur, especially in second growth stands of poor quality. Blister rust infections were noted in the crowns of large trees, but had not yet caused appreciable damage there.

Young growth. While no estimate was made of the actual incidence of damage to young pine on account of blister rust, in the Ganaraska region, the rust was observed everywhere throughout it, and a high rate of severe infection and mortality was observed at several localities, particularly in the headwaters region. In the Durham forest, severe damage was seen on trees 6 inches to 8 inches D.B.H., thirty to forty feet tall, while dead and dying trees of 6 to 10 feet in height were common. It is evident that a large proportion of the young stock of pine in stands naturally reproducing to pine and other species will be lost.

[d] Fungi Noted on Chief Timber Trees (see Appendix).

4. FISH[1]

As recorded in another section of this report, there was at one time an abundance of salmon in the Ganaraska River, but it was practically left out of account by Wilmot in his salmon cultural work in the 1870s, perhaps because there was an unpassable mill dam across it "a short distance from the lake shore thereby leaving no space for spawning beds" (Wilmot, Ann. Rap. de Mar. Fisher. 1873 Fisher. App. p. 118, 1878). It was however reported for 1873 that "quite a number of salmon were seen" in it. The only attempt to populate it with salmon seems to have been a planting in 1878 (Wilmot Fish. Rep. 1879 Pt. 2, p. 16, 1880), just as the salmon were disappearing from the lake.

[1]Survey made October 25, 1943, including data from collections, September 25, 1941, and other information from the Ontario Department of Game and Fisheries.

While still populated with runs of salmon and subsequently even up to the present time, the speckled trout has been an inhabitant of this river system, although now this species is for the most part confined to the upper reaches of the tributary streams.

Plotting the slopes from the contour lines on topographical survey maps it was found (Huntsman) that from Kendal down, the Ganaraska River had a gradient or slope of 20 feet to the mile. Report cards of the Game and Fisheries Department give gravel bottom as predominant, forming from 75 to 90 per cent of the bottom. In the upper reaches of the tributaries there is a relatively high proportion of gravel and small to large stones with logs and other obstructions occurring frequently which form suitable shelter for the trout, but in the lower reaches the gravel beds are to a fairly large extent massed with sediment which has been carried off the adjacent land. This sedimentation is related to the erosion from cultivated fields and the low gradient or slope which does not produce sufficient current to carry it on down stream keeping the gravel beds clean.

On October 25, 1943, speckled trout were found or reported from all of the tributary streams crossing the Kendal-Garden Hill road with the exception of the most easterly tributary. The only fish found associated with these trout were the sculpin, *Cottus cognatus* and longnose dace, *Rhinichthys cataractae*. Trout were found as far south as the Perrytown road where they were associated with a large population of suckers, chub and sculpins.

The most easterly tributary of the Ganaraska, crossing the highway at Garden Hill was quite different in nature from the other tributaries, being a broader, more slowly flowing stream lacking trout, but contain such species as:

Common white sucker, *Catostomus commersonnii*, bluntnose minnow *Hyborhyncus notatus*, common shiner, *Notropis cornutus*, fathead minnow, *Pimephales promelas*, creek chub, *Semotilus atromaculatus*.

Samples of the fish population taken where the tributaries cross the concession line south of the Kendal-Garden Hill road and from there to the mouth, included such species of fish as:

Common white sucker, *Catostomus commersonnii*, blacknose dace *Rhinichthys atratulus*, creek chub, *Semotilus atromaculatus*, common shiner, *Notropis cornutus*, Johnny darter, *Boleosoma nigrum*, longnose dace, *Rhinichthys cataractae*, bluntnose minnow, *Hyborhynchus notatus*.

The species of fishes included in this list are characteristically warmer water fish than the speckled trout, and as in the case of the river at

Perrytown, speckled trout are only occasionally found in community with these fishes.

The presence of this community of warmer water fishes and the absence of speckled trout in all except the upper reaches of the streams may be in part associated with the lesser gradient found in the lower reaches and in part with the absence of shelters and refuges for the trout and sedimentation arising from cultivation of adjacent lands and destruction of protecting grass and woodlot borders along the course of the streams. These conditions arise as the result of agricultural exploitation of lands bordering the stream.

Activities looking toward the improvement of streams for the best development of the game fish, in this case the speckled trout, must consider both the maintenance of favourable conditions along those reaches where it now exists and the extension of such conditions to as great an extent as possible along those parts of the stream where conditions have been found to favour the warm water fish and by the same token are unfavourable to the speckled trout. Such an undertaking involves both a study of conditions favourable to trout as they exist and a programme for re-establishing favourable conditions in contiguous reaches of these streams.

CHAPTER FIFTEEN

Recommendations For Future Surveys

1. GENERAL CONSIDERATIONS

THE chief difficulty in carrying on surveys during wartime is the procuring of a competent staff in sufficient numbers. Under the present Selective Service regulations, students as well as recent graduates of our universities come under the call of wartime duties. This, of course, is as it should be, and the fact is mentioned here not by way of criticism, but to indicate the difficulties which must be faced in carrying on such work. The use of school teachers, however, has proven very satisfactory because in this profession experts in most of the sciences can be found. The drawback, however, with this type of help is the shortness of the summer vacation in which field work can be done, and which ordinarily does not exceed six weeks. Due, however, to the urgency of the present work, and its close association with post-war problems, the field work could be expedited materially if arrangements could be made with the respective Boards of Education for the release of competent men for a week or two in the spring and fall, in order to extend the field work to a period of at least three full months.

Considering the nature of the different surveys involved, the supervisory staff, at least, should have a broader representation from the different sciences concerned. If such men could be found for summer work only, it would be an advantage to have a skeleton staff to guide assistants working with each party in the field in the following sciences: one agriculturist, trained in soils and agronomy; one farm economist; one forester; one hydraulic engineer; and one biologist. In this way the work could be better co-ordinated in the field and the problems could be dealt with more efficiently as they are met.

The arrangements made for the surveys in 1942 proved adequate for the task in hand. The only deficiency was the proper co-ordination of the different sciences referred to above, but this was overcome as much as possible by using the generous assistance of other government departments and the teaching staff of Toronto University and the Agricultural College, Guelph.

One type of work which should be given more consideration on future surveys is the question of hydrology, which includes such items as water supply, stream flow, and dam sites on the river.

The use of aerial photographs is the modern and most rapid method of making land use surveys. These were of great value on the Ganaraska survey and reduced the field work by many times. As the taking of such photographs is dependent on the vagaries of the weather—and for this reason often must be delayed—it is necessary that they be taken as soon as possible after the area to be surveyed is decided upon.

While such surveys are a means of planning for immediate work projects after the war, the fact that such work when done must have permanent supervision makes it necessary that certain research problems be undertaken as soon as possible. The most important of these, is the study of hydrologic influences, in order to obtain data on such questions as water supply in wells, stream flow, and other influences which might change over a period of time, when the rehabilitation of a section of the province is undertaken. This would involve the establishing of gauging stations on the rivers and streams, and the accurate measurement of the depth of water in wells, studies in connection with the water table, as well as the establishing of a weather station, if one is not already on the area. Such research work would make it possible to compare conditions on the area before the work started, with conditions during successive years, as it is accomplished.

Furthermore, a periodic record of the factors indicated above is the only way of presenting a co-ordinated picture of the value of such measures. At present many of these relationships between natural phonomena in Ontario at best are purely hypothetical, and such accurate data as suggested would not only serve as a record of what is taking place, but also as a guide for future projects.

2. CONSERVATION BOARD

On any land use survey such as the one undertaken on the Ganaraska, where it is required to collect data included in different sciences, it is important that there be close co-operation of all departments involved, both federal and provincial. As already indicated, such work includes soils, hydrology, agronomy, soil erosion, forestry, surveying, farm economics, biology, as well as historical research. In some departments of the government, work in these fields, for a given area, has already been done, and the closest co-ordination possible should be arranged to expedite the work.

In order to bring this about, it is recommended, therefore, that a body of scientifically trained men be appointed by Order-in-Council, to be known as the Ontario Conservation Board, with representatives from the several departments concerned, and additional personnel drawn from outside government departments, where necessary. This Board should

have among its members representatives of at least the following fields of investigation: forestry; soils; crops; livestock; wild land animals; aquatic animals; water engineering, including hydrology; meteorology; public health; and agricultural economics.

The scope of the Board's work, and the manner of procedure, would be as follows:

(1) Surveys would be undertaken by the Board which would include general reconnaissance of the several areas, as well as the later collection and study of data on land use, erosion of various kinds, flood control, reforestation, wildlife and other associated problems. From this information, the particular conservation measures could be determined.

(2) Studies which are peculiar to one department of the government, and which are not being carried out at the present time, may be initiated by the Board, in conjunction with the department concerned.

(3) Studies which have been completed, or are under way in any department, which have a bearing on the work of the Board, may be made available to the Board, providing that the furnishing of such information in no way shall be prejudicial to the work of the department concerned.

(4) An item would be placed in the estimates to be used by the Board for salaries, travelling expenses, office equipment, etc., of a skeleton staff, to give permanency to the work of the Board throughout the year.

(5) Additional appropriations would be made from time to time to carry out projects recommended by the Board.

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CONSERVATION MEASURES

"Man cannot successfully make over nature, but he can correct his own abuses of nature"

CHAPTER SIXTEEN

The Ganaraska Forest

THE most important conservation measure recommended is the establishing of a forest on the northerly part of the watershed on what is known as the interlobate moraine. This moraine is a long narrow area of sandy loam and gravel country which extends throughout a part of southern Ontario, commencing in York County and reappearing again in Ontario and continuing through Durham and Northumberland counties. (See Page 2). The area included in the proposed forest is approximately 20,000 acres, much of which is plantable land and woodland, with here and there farms of low productive value. It is on this forest that most of the employment for returned men would be found, although as will be shown subsequently, there are many other useful projects to be undertaken farther down the watershed.

In outlining the types of employment which could be provided, it would be well to indicate here, although this has reference to other sections as well, that forest work is seasonal. The period of the year during which such projects could be carried on would not exceed nine months, and would extend, as a rule, from April to December, inclusive. The remaining three months do not lend themselves to outdoor work as described hereafter, since the depth of snow on the upper part of the watershed—in some winters four to six feet—makes woods work impracticable. In some years, also, winter sets in in the middle of December and the roads are not passable for vehicular traffic until well on in April. During the winter months a skeleton staff could remain on duty, and for those who could not conveniently leave the project, some type of vocational training might be arranged.

In dealing with the different types of work, these will be explained in detail and some idea of the time required for the different operations will be given. The types of work have also been summarized in table form, giving the number of man-hours required for each, and the approximate cost. (See Page 222).

In converting man-hours to money, or vice versa, the rate of twenty-five cents an hour has been used. This figure, plus allowance for board and lodging, estimated at $1.00 a day, would bring the daily wage of each man to $3.00 for an eight-hour day. It is impossible to forecast what the rate of pay will be for such work after the war, but in support of the above rate, which is used only for the purpose of arriving at an approximate cost of such projects—the man-hour figure being convertible

to any rate—it should be stated that the rate of pay for ordinary labour at the provincial nurseries and county forests up to March 31st, 1938, was 25 cents an hour. Since then the rate has been increased five cents an hour each year, until at present it is 45 cents an hour, with no allowance for board and lodging.

1. REFORESTATION

[a] General Considerations:

Before considering specific kinds of reforestation work it would be in order to outline briefly the preliminary steps necessary in procuring a supply of planting stock for a large project.

The first step in any programme of this kind is the securing of tree seed. This is done usually by hiring men, women and children to pick the cones or hardwood seed on a piecework basis, at so much a bushel. In the case of cones, they must be picked from the trees when the seed is ripe but before the scales open and allow the seed to be released. In the case of coniferous species, the period during which the picking can be done extends for only two or three weeks. This applies to white pine, white spruce, hemlock and balsam. Other species such as red pine, jack and Scotch pine, and cedar, have a longer collecting period which varies, depending on the weather and the frequency of frosts.

The uncertain factor, however, in seed collecting is not so much the shortness of the picking season, or the procuring of labour—since this can be adjusted by increasing the price paid for cones—as the infrequency of seed years for certain species. White pine and white spruce as a rule produce a crop every second year. Cedar, hemlock and balsam are more spasmodic, but since no large quantities of these are required at one time, a fair crop usually can be collected somewhere in the province every second year. Jack pine and Scotch pine also do not present a problem in this regard because jack pine cones remain on the tree for more than one year and under ordinary conditions Scotch pine seed of good quality can be imported, although cones of this species are collected regularly from older plantations in Ontario. Red pine, which is used more than any other species at the present time, is more intermittent, and regularly misses two or three years for a full crop in the same area. In fact, this species has been known to produce an indifferent crop in certain areas in as many as five or six consecutive years. Fortunately, however, by improved methods of extraction and cleaning, and by storing seed in a constant temperature of approximately 36 degrees F., the viability of the seed can be retained, with little loss, for several years.

It has been the policy of the Department of Lands and Forests for several years past, in its seed collecting work, to gather, so far as pos-

sible, a sufficient supply of the more important coniferous seeds whenever a good crop is available and to store it, under refrigeration, against the years of scarcity. For the sake of general information it might be stated here that at the present time the quantities of seed in storage by this Department are as follows: (February, 1943).

Conifers		Hardwoods	
Red Pine	3,618 lbs.	Black Locust	101 lbs.
White Pine	431 "	Honey Locust	51 "
Scotch Pine	167 "	White Birch	78 "
Jack Pine	158 "		
White Spruce	542 "		
Norway Spruce	82 "		
White Cedar	600 "		
European Larch	60 "		
Miscellaneous	141 "		
	5,799 "		230 "

Also, it should be stated that the three nurseries of the Province use approximately the following amounts of seed each year in their nursery programme: (1940)

Conifers	Hardwoods[1]
4,726 pounds	1,239 pounds
	754 bushels

At the nurseries coniferous seed is planted in beds and allowed to grow for two years, in the case of pines, and sometimes longer in the case of spruce. The young trees are then transplanted into larger beds and allowed to grow for at least one year, at which time most species are ready for permanent planting.

It will be seen, therefore, that the period of time from the securing of seed to the production of planting stock is a factor which too frequently is overlooked. The minimum time which must be allowed between seed collecting and permanent planting stock is three years. Therefore, providing that the seed required can be obtained, it would be impossible—even if other things are equal—to have on hand a large stock of coniferous planting material before this period of time has elapsed.

The procuring of hardwood seeds and the growing of these is not nearly as difficult a task as the collecting and growing of conifers. Hardwood seeds can be picked from the trees direct, or gathered from the

[1]Some hardwoods such as locust are measured by the pound, others such as walnuts, by the bushel.

ground after the seeds have fallen, and with the exception of two or three species, are not stored from one season to another. They also respond very easily to nursery practice and, except in the case of a few species, can be used for permanent planting after one year in the nursery. In addition, the quantity of hardwoods used on large reforestation projects in Ontario is only approximately ten per cent of the total number of trees used in any one year. From the foregoing it will be seen that where a large planting programme is contemplated, the acquiring of a good stock of young trees should be given early consideration.

As a guide to the available stock on hand in any one year it may be stated that the number of trees suitable for planting, in the three Government nurseries in the spring of 1943, was twenty-three million conifers and hardwoods. Such a supply has been maintained at practically the same figure for the last five years. The output of stock could no doubt be increased although it is doubtful whether the nurseries could handle twice this quantity—which would be the amount required for large projects, without the purchase of more suitable nursery land and additions of competent labour being made to the staff. If, however, it should be necessary to embark on a large reforestation scheme within the next year or two, a considerable quantity of stock could be made available by reducing the regular distribution to private planters, and to county forests. Coupled with this fact too, it should be remembered that the planting of trees is seasonal work and cannot, at the most, be carried on for more than six weeks, in the spring and fall of each year. Also, it is not intended that all the planting work on any project should be undertaken the first year but should be a part only of the general works programme.

[b] Site Clearing:

Where tree planting on abandoned farm land is carried out on a large scale, there is usually a certain amount of cleaning up to be done before the planting crews are started out, or if circumstances necessitate some of this cleaning up can be done during the first season after planting. This consists of cutting down isolated trees scattered over the plantable areas, such as pine, maple and elm, most of which may have developed large crowns. If these are allowed to remain, they leave holes in the young plantation. Once an area is planted and the trees reach a height of over four feet, it is difficult to remove such large trees without injuring the surrounding smaller ones.

Also, along old fence lines and around old building sites, there are usually rows and small groups of trees and, in some cases, worn-out orchards; all these have to be removed. An estimate of this type of work was made during the summer, when the land use survey was in progress, and from the records obtained it is shown that there are 4,000 trees of various sizes which should be taken out. Much of this material

Eight thousand acres of plantable land, including severely eroded areas, are

is small and of little value; some of it, however, would make saw-logs, while a great deal of it could be used for fuel.

[c] Tree Planting on Open Land:

The species of trees being used mostly for planting on the type of land found on the large areas of the proposed forest, are conifers such as red, white, Scotch and jack pine, larch and spruce. As a rule these are planted in mixtures of varying quantities and occasionally hardwoods are used with them on the better sites. Shallow furrows are plowed six feet apart on the area and two men work together, one man carrying the trees in a pail half full of water, and the other man digging the holes. In this way they work down each furrow, planting the trees six feet apart. At this spacing, it requires 1,210 trees to plant an acre. Usually, however, in actual practice, over large areas, the figure used is 1,000 trees per acre. The cost per acre varies with local labour conditions and other factors. But from the county forest records, which extend over

included in the proposed Ganaraska Forest—The 9th Concession of Clarke.

seventeen years, the cost of planting 3,654,000 trees on three forests adjacent to the Ganaraska, namely York, Durham and Northumberland, was $5.75 an acre. On the proposed Ganaraska Forest, the total area of open plantable land—not including that which is badly eroded, which will be dealt with separately—is 6,497 acres.

[d] Planting in Woodlots:

Since many of the woodlots have suffered from over-cutting and grazing, these should be supplemented with suitable species of hardwoods in the hardwood stands, conifers in the mixed stands, and conifers as an understory where the stocking has run to inferior hardwoods such as poplar. Woodlot planting is not as rapid as planting on open land, because of the necessity of using a method of spot planting instead of furrows, and also because of obstructions such as roots and other vegetation. No accurate figures can be given for the acreage per day of such planting, but two men should plant at least five hundred trees.

From the woodland reports made out on the survey, it is estimated that such planting would require 2,682,000 conifers and 2,000,000 hardwoods.

[e] Hardwood Plantations:

Many of the thrifty stands of timber found on the area are mixed hardwoods. This is an indication that these species, as well as conifers, thrive well on this type of soil. As a rule, however, hardwoods prefer the better soils and these would be planted wherever the soil is more favourable. Such work could include the planting of some fast growing poplar on some of the better sites.

The planting of hardwoods requires more planning and care than the planting of conifers. Usually with these it is customary to plow and cultivate the area before planting, in order to keep down weeds which spring up more rapidly on the better soils. If the area is not cultivated and the trees are planted in furrows the same as conifers, it is necessary to do some hand cultivating during the first year or so, and also to prune the lower branches, or sprout growth, which invariably occurs in young hardwood plantations. The planting of such species on the proposed forest would be comparatively small, and would be done more from the standpoint of variety, or as an experiment with certain mixtures, than as a routine programme. Such work could be carried out on 1,500 acres.

2. EROSION CONTROL

Two classes of soil erosion, namely wind and gully, require special attention on certain plantable areas. By wind erosion is meant areas where forest and ground cover are completely removed and the soil is being drifted by the wind. On many such areas some method of stabilizing the soil must be used before regular tree planting can be proceeded with. This is done by spreading brush in windrows, if such is available, and by planting wide belts of fast growing willow and poplar. After the willow and poplar have grown sufficiently to check the force of the wind, conifers are planted between the windrows, or in the case of brush on small areas, they are planted as soon as the brush is laid down. Such planting, of necessity, is more costly than open land planting and averages at least $10.00 an acre.

Gully erosion is caused usually by severe washing when the snow goes off in the spring, or during heavy showers in the summer; and is sometimes accentuated by wind. There are many large gullies of this kind on the face of the moraine and before planting can be undertaken some mechanical method must be carried out for checking the run-off.

Courtesy of U.S. Soil Conservation Service.

Small check dams are used for the control of gully erosion. These are built of stones, logs, fence-wire and straw, or whatever suitable material is handy. The idea is to compel the water to walk, not run, and as it walks to deposit its load of silt and sink into the ground.

During the fall of 1942, while the Ganaraska survey was in progress, thirteen erosion check dams were erected in badly washed gullies to test out the efficiency of different materials. These consisted of stones, logs, brush, fence-wire, chicken-wire, straw and willow wattle (small willow poles woven like a basket). It is difficult to estimate with accuracy the number of these dams required, or what the cost would be, without levels being taken of the needy areas. However, from estimates made on the ground it is reported that 36 areas of this kind require treatment involving the erection of 360 dams. These, based on the test dams already erected, would require 5,760 man-hours, not counting material.

3. IMPROVEMENT THINNINGS IN EXISTING WOODLOTS

Woodlots are usually classified under three general headings. First, the even-aged woodlot, which contains trees of the same age, the majority of which are the same size. Such a stand usually is spoken of locally as "second growth". Second, the uneven-aged woodlot, in which are found trees of all ages and sizes, from a few inches in height to virgin timber. The majority of woodlots in the rural sections of Ontario are of this class. Third, the coppice forest, which is composed of coppice

or sprout growth from the stumps of hardwood species. Such growth occurs where birch, poplar, soft maple, basswood, and other hardwoods are clean-cut for fuel wood or other purposes.

All three classes of woodlots are found in the proposed forest and in almost every instance some improvement work could be carried out. This would include the cutting of large mature trees, the removal of dead and fallen trees, and trees attacked by disease or infested by insects, usually referred to as sanitation cuttings; defective and crooked trees, weed trees, and those having wide spreading crowns. Such improvement work would include the cutting of this material into fuel wood, as well as the scattering or burning of brush. Based on figures available for this class of work in similar parts of southern Ontario, the time required would amount to 60 man-hours per acre. Of the total area of woodland in the proposed forest, 4,687 acres would require improvement of some kind.

4. PLANTATION IMPROVEMENT

The purpose of planting trees six feet apart is to ensure a forest cover on the area as soon as possible. When this occurs the lower branches of the trees begin to die. If time and funds will permit, it is always advisable to remove these branches as soon as they are dead. In actual practice, however, this is not done until the trees reach a height of at least ten feet.

On the proposed forest there are 767 acres of coniferous plantations ten feet in height and over, including those found in the Durham Forest. The cost of such work, including pruning and brush disposal, would average 32 man-hours per acre. Such work would serve a two-fold purpose, since besides improving the plantation, it would provide excellent material for wind erosion control at certain sites and also provide needed material for erosion check dams.

Plantations fifteen feet and over also require thinning. The number of plantations of this size on the area amount to only 146 acres. This type of work would average 24 man-hours per acre. In addition the thinnings will usually furnish an inferior class of fuel.

5. FENCING

In the establishing of a forest property such as is proposed, it would be necessary to provide adequate fencing for the boundaries. For the most part, the properties which would form the boundaries of the forest are now fenced in some way, but these would have to be repaired or rebuilt where necessary. It is estimated interior fencing on the inside

The type of work providing most employment on the whole watershed is the cutting of over-mature, suppressed and diseased trees from existing woodlots—The 7th Concession of Clarke.

properties would be sufficient to provide a complete boundary fence. In addition, there is a great deal of interior fencing which is in a dilapidated condition and which would serve no useful purpose. This should be removed, where it interferes with the progress of planting, and the best of this fencing could be salvaged for other uses, or for sale, as necessity demanded.

The boundary of the forest is 38 miles in length and allowing for the rebuilding or repairing of half of this at one dollar a rod, would require 24,320 man-hours.

The amount of interior fencing to be removed, exclusive of fences along the roads, is estimated at 97 miles. The removal of this at 25 cents a rod would require 31,040 man-hours.

6. ROAD AND TRAIL BUILDING

Every forest area must be accessible, for the purpose of fire protection, planting, woodlot management, and the combating of disease and

U.S. Forest Service photo.

Over sixteen hundred acres of forest plantations have been established on the watershed. The pruning and thinning of these would provide many hours of employment.

insects. A system of woods' roads must be laid out suitable for taking care of vehicular traffic. In addition, it is customary to build fire-guards, or fire-roads, chiefly around the boundaries of forest properties in southern Ontario, and in the interior where the other roads do not provide accessibility for forest work. On the proposed forest 10 miles of road should be built, at an average cost of 360 man-hours per mile, and fire guards required are estimated at 8 miles, at 160 man-hours per mile.

CHAPTER SEVENTEEN

Municipal and Private Forestry

1. REFORESTATION

IN addition to the plantable land included in the Ganaraska forest there are many smaller areas of this kind scattered throughout the southern part of the watershed on privately owned property, totalling 2,686 acres. These are small areas constituting parts of farms which cannot profitably be used for agriculture, and are the concern of the individual owner and should be planted with trees. Where these areas occupy whole farms, or are important from the stand-point of the public good, such as the protection of headwaters of streams, they should be the concern of the county or township council.

As mentioned elsewhere in this report, some remedial measures are being carried out on private land on the watershed and, to assist in this, a system of free distribution of trees for private planting has been in operation in Ontario for the past thirty-eight years. In recent years, however, Amendments to the Statutes of the Province of Ontario have made this work more encouraging for the private owner.

In 1906 a Statute was passed making it possible for a township council to exempt a certain percentage of woodland from taxation. This Act provided that:

"Any part of a farm used for forestry purposes or being 'woodlands'; provided that such exemption shall not be greater than one acre in ten acres of such farm and not more than twenty acres held under a single ownership."

" 'Woodlands' for the purposes of this paragraph shall mean lands having not less than four hundred trees per acre of all sizes, or three hundred trees, measuring over two inches in diameter, or two hundred, measuring over five inches in diameter (all such measurements to be taken at four and one-half feet from the ground) of one or more of the following kinds: White or Norway pine, white or Norway spruce, hemlock, tamarac, oak, ash, elm, hickory, basswood, tulip (white wood), black cherry, walnut, butternut, chestnut, hard maple, soft maple, cedar, sycamore, beech, black locust, or catalpa, or any other variety which may be designated by Order-in-Council, and which said lands have been set apart by the owner with the object chiefly, but not necessarily solely, of fostering the growth of the trees thereon and which are not used for grazing live stock."—R.S.O. 1927, c. 238, s. 4, par. 25; 1934, c. 1, s. 4 (3).

However, from the time the Act was passed, until 1927, it was practically inoperative because the granting of such exemption was optional with the township council and such bodies did not encourage policies which reduced their taxes. In 1927 the exemption of taxation on woodlots was made compulsory, if applied for, and is interpreted as meaning planted trees as well as trees which grow naturally.

Prior to 1938 complaints were occasionally made by persons carrying on large reforestation schemes, that the assessment on such areas was raised after they had been planted. This was discouraging to public-spirited citizens who purchased unused land, often at a tax sale, and planted it with trees. It is well known that for the first fifteen years at least, such a property is an expense to the owner and brings in little revenue, therefore it seems reasonable that taxes should be stabilized for the first few years. In 1938 the Assessment Act was amended to provide for this, and now reads as follows:

"Land which has been planted for forestation or reforestation purposes shall not be assessed at a greater value by reason only of such planting."—The Statute Law Amendment Act, 1938, c. 37, s. 2 (1). These two improvements in the laws of the Province should be a further incentive to private citizens on the Ganaraska to carry on reforestation work.

Within the last year, also, the Department of Lands and Forests has instituted a policy of setting up forest zones in southern Ontario with a technical forester in charge of each, whose duty it is to give advice and assistance in planting, reforestation, and in the management of farm woodlots. Literature on these subjects is also available on request. A Zone Forester is located at Orono, just over the boundary of the watershed, and this office is equipped to assist persons in the area.

The areas of poor land below the Ganaraska forest which are too large for handling by private persons, should be the concern of the township councils. As will be mentioned later, a small beginning has been made in this direction by the townships, but not nearly enough to indicate that these governing bodies are sincerely interested in the problem. Assistance in this regard and the supplying of free trees is still the policy of the Department of Lands and Forests. Moreover, as provided by the amendment to the Counties' Reforestation Act, it is possible for a township council to enter into an agreement with private land owners for the reforestation of their property.

"The amendment permits the municipal council of a township to enter into agreements with the owners of land providing for the reforestation of portions of such lands. The agreements will prescribe the cutting conditions of all trees planted and such conditions will be subject to the approval of the Minister of Lands and Forests.

"Provision is also made for exempting such lands from taxation and for making arrangements with the Dominion and Provincial Ministers of Labour regarding conditions of labour and payment of wages in connection with the planting and conservation of such areas."—The Counties' Reforestation Amendment Act, 3 George VI, 1939, c. 11.

Under this arrangement lands which are of strategic value for the control of erosion on highways or the protection of the headwaters of streams, or simply for the utilization of non-agricultural land, can be reforested by agreement between the township council and the individual.

In carrying out the proposed works programme, there would be an opportunity, under this Act, for the planting of private woodlots in the area, providing agreements were made between the township council and the parties concerned. It may not be advisable to plant the total area of 2,686 acres shown by the land use survey, but for the purpose of calculating the approximate amount of work needed in this field, if half the area were planted it would provide for 30,889 man-hours. In addition erosion planting would provide for 12,240 man-hours.

2. CONTROLLED WOODLOT MANAGEMENT

Before the necessary conservation measures on that part of the watershed exclusive of the proposed Ganaraska Forest can be properly co-ordinated, some system of controlled cutting of privately owned woodlots must be established. The reason for this is that the average owner does not take a broad view of the value of forest cover and is not interested, to any great extent, in what may happen to land or stream flow off his property. The result is that throughout the watershed there is a systematic cutting of woodlots, both for the purposes of lumber and firewood. This type of cutting has been in progress for many years, and the portable sawmill has done a great deal of damage in removing, particularly, young thrifty trees. The system of selling acre or half-acre blocks of timber for fuelwood is also another vicious practice, for the reason that when a purchaser buys such a block, in nearly every case he clean-cuts every tree which can be used, down to an inch or two in diameter. Some system of regulating cutting would correct this situation, and certainly the areas which are connected in any way with the headwaters of streams, or the feeding of springs, should be controlled to the extent that they cannot be clean-cut.

Where conditions warrant, a certain amount of cutting could be continued, but such trees should be marked by a competent person and provision made for restocking, where necessary. The intention would be to interfere as little as possible with the economy of farm property,

where the supply of wood is concerned, but in some cases it would be necessary to subsidize the owner in the form of supplying him with fuelwood, or the occasional stick of timber. A large quantity of such material would be available, however, from thinnings and improvements from the Ganaraska Forest, and could be used in this way.

The question of clean-cutting of woodlots on this area, and for that matter throughout all of southern Ontario, is of serious import, and is one of the chief reasons why some system of control should be instituted. For many years now conservationists have advocated controlled cutting of woodlots. In some sections, particularly in tobacco growing counties such as Norfolk County, the disappearance of woodlots for the curing of tobacco has become alarming. It is admitted that the question requires delicate handling, but where the good of the whole community is envisaged, some middle road of agreement could be arrived at. Furthermore, the distribution of free trees by the government for conservation purposes is sometimes criticized, and rightly so, where on one farm the owner plants an area with seedlings and in the same year his neighbour clean-cuts a woodlot which perhaps protects the headwaters of a stream. In fact, so distorted is the relative value of tree planting versus established woodlots, in the minds of some people, that there are examples on record where municipalities have purchased land for reforestation and have allowed the owner to cut the timber before giving title.

It is admitted, of course, that there are extenuating circumstances when a farmer may consider it necessary to raise money by selling timber. This in itself is not so serious if the cutting is done in such a way that the benefits of the forest are retained. Young forests, as well as old, protect the soil and have water regulating value, and the clean-cutting of such areas is a destructive and vicious practice which should be stopped.

The basis on which a regulation of this kind should be carried out is a consideration of the woodlot concerned. To make a blanket ruling that all woodlots on the Ganaraska should not be cut, or should come under one type of control measure, would not work to the best advantage of the community, and certainly would not be in the interests of good forestry.

Some woodlots have reached the stage in which they are worn out and if the land is good, should be cleared off and cropped. Others may be composed of a high percentage of worthless species and have no relation to water regulation in the countryside, and likewise could be disposed of to advantage. But, where the woodland has a direct bearing on water regulation, erosion, retarding of the wind, and similar benefits, the desire of the individual should be sacrificed for the good of the community. The whole question, therefore resolves itself into an examina-

Before the necessary conservation measures can be properly co-ordinated, some system of controlled cutting of privately owned woodlots must be established. The portable sawmill has done a great deal of damage in removing, particularly, young thrifty trees—The 9th Concession of Clarke.

tion of each woodlot by a competent person, and the prescribing of a programme of management to suit each case.

The basic method of control usually advocated, is cutting to a diameter limit, that is, that all trees below a certain diameter—for example five inches—should not be cut. Such a regulation may or may not be good forestry. In most cases it would not be, because there would be much worthless material below this diameter limit, such as poplar, thorn, willow, and other species, which should be taken out. At the same time there would be certain large trees above the diameter limit which should be left for the benefit of the forest, as well as trees suitable for re-seeding the area. The diameter limit should not be a fixed rule, but simply a guiding principle; a sort of yardstick on which the land owner can base his calculations. In an area the size of the Ganaraska, a programme of individual woodlot examination should not be too heavy a burden on the local forest authority.

When the land use survey was made in 1942, each woodlot on the Ganaraska was examined, so that there is already on file a report showing the condition of each of these and from the reports the necessary data has been deduced, which indicates the types of work which are most urgent. These consist of improvement thinnings and planting, which would require 37,500 man-hours, with an additional 5,440 man-hours for thinning plantations. Such a service could be counted by the land owner as a form of subsidy, in return for relinquishing absolute cutting rights in the woodlot. It should be clearly stated, however, that all land on which regulated forest is found would remain in the possession of the present owner, and the woodlot would still be his to possess and enjoy as before, but the intrinsic forestry value of the area would be controlled to the extent that its benefits in this regard would remain permanent for the community.

CHAPTER EIGHTEEN

Flood Control

THE principal factors contributing to increases in the frequency of floods on the Ganaraska River are mentioned in previous chapters and may be summarized as denudation of forest cover and the drainage and development for agricultural purposes of the major portion of the watershed. As a complementary condition to the increase in spring run-off is the reduction in summer flows. Reforestation of relatively large areas may, therefore, be expected to reduce the frequency of these floods and materially improve summer flows. The benefits to be derived from reforestation will, of course, not be effective for a considerable number of years after planting.

1. FLOOD CONTROL REPORTS FOR THE TOWN OF PORT HOPE

The most serious damages resulting from extreme floods on the Ganaraska River have been principally to properties in or near the town of Port Hope. In 1937 this municipality secured reports on flooding from H. G. Acres & Company and James, Proctor & Redfern, Consulting Engineers.

In reviewing the situation Dr. Acres gives a survey of conditions affecting floods and their relation to Port Hope, from which the following excerpt is made:

"It is of course a recognized fact that there have always been floods on all rivers, but there should also be a general realization of the fact that the march of civilization, within the law, has by gradual evolutionary process destroyed the rainfall retention capacity of our river basins on the one hand, and on the other has placed more and more expensive obstructions and realty values in the path of the resultant floods. It is these two divergent elements of flood damage, in the modern sense of the term, which make flood prevention and control projects so difficult to organize and finance.

The Town of Port Hope, in the present instance, has no recourse in law against the persons and agencies responsible for the lack of rainfall retention capacity in the 105-square-mile basin of the Ganaraska river, which was the underlying cause of this winter's heavy damage. The lumbermen removed the forest-cover under government license. The Province, the counties and townships built their highway and drainage

ditches under statutory authority, and the farmers cleared and drained and continue to plow their fields under the protection of the common law. Obviously, therefore, the only recourse which is available in the premises, to a sufferer from the devastating results of Government initiative, is against the Government itself, but the Government is not subject to the ordinary processes of law. Nevertheless, it is in theory the function of the Government itself to bear the responsibility and the cost of restoring the primeval regimen of our rivers. This is logical because such restoration could be effected without suffering or damage, but only benefit, to every interest involved, being in this regard the reverse of present policy. On the other hand this theory is not practical, because the present generation can only imagine, but cannot prove, what the primeval regimen of our rivers was; but the principle itself holds, and can and must be a factor in fixing the nature and extent of the Government's and counties' participation in any flood control scheme.

The immediate purpose of the above argument is to prove that in the present emergency it is not possible or practicable for the Town of Port Hope, alone and unaided, to consider any remedial measures involving flood control, or flood prevention, and that, therefore, it should confine its activities to the prevention of flood damage within its own corporate limits, if it wishes to protect its own property, which consists principally of its streets and bridges. Apart from this immediate emergency, comprehensive flood control, as distinguished from prevention of local flood damage, is necessary and practicable and it lies primarily within the sphere of Government initiative.

The reasons why the town and townspeople should take steps for the prevention of flood damage to their property within the corporate limits, when the primary agency causing such damage still exists unimpaired, and beyond the power of the town itself, or any of its inhabitants, to remedy or control, should have some explanation.

These reasons are:—

First, because even if the Government recognizes its responsibility for flood prevention control, as a matter of policy, it can never be made tangibly and retroactively responsible for local flood damage, as a matter of law.

Second, because in this particular instance the damage suffered has in part been due to local buildings and other structures built in the path of the flood waters.

And *finally*, such costs, in my opinion, are a charge against the community as a whole, because the damage and hazard involve not only streets, bridges and other public property, but have as well a direct reaction against the assessment, business and realty value of all private

property within the corporation limits, so that the hazard associated with the future occurrence of damaging floods as great, or greater than those of the present winter, indicates the necessity of prompt remedial action under municipal auspices.

The argument up to this point leads to the conclusion that the town cannot itself undertake any project for flood prevention or control, but that it may and should initiate measures for the prevention of flood damage within its own corporation limits, in an endeavour to protect its own property."

James, Proctor & Redfern, in their report dealt with measures for the prevention of flood damage within the corporation limits and listed the following items with their approximate costs:

Excavating and removing two islands in the channel of the river	$ 4,000.00
Constructing a new spillway under the Canadian National Railway tracks adjacent to the Nicholson Dam	25,000.00
Excavation work below Nicholson Dam	21,000.00
Excavation and wall at Marshall's Dam to Walton Street	12,500.00
New Walton Street Bridge and adjacent works	21,000.00
Excavation below Walton Street to Rapids	19,500.00
Additional work	5,000.00
Engineering and contingencies	22,000.00
	$130,000.00

In both these reports the emphasis naturally is on engineering works to be constructed or carried out within the town limits. These works, or a modification of them, are decidedly necessary, considering the flood situation as it is to-day. The wider view of the cause of floods, not being of immediate concern to the townspeople, is not developed by Dr. Acres. However, one reason why this matter is raised in this present report is for the purpose of pointing out to the people of Port Hope that the larger view of conservation measures should be envisaged, because from an economic point of view the farming community on the watershed north of Port Hope is of concern to the business men of the town, and they should at least assist in giving leadership to a scheme which would embrace remedial measures on the whole area.

The seriousness of the situation is not so much the fact that floods periodically occur in Port Hope, but rather that the beneficial effects of a great deal of this water are lost to agriculture, as it relentlessly and persistently carries away the topsoil of the land, thus lowering the purchasing power of the farmers. In other words, the silt which annually goes down the Ganaraska River is not just so much mud being

Narrow bridges, dams and buildings, as well as the shallow channel of the river formed by the exposed bedrock, all aggravate flood conditions within the Town of Port Hope.

dumped into Lake Ontario, but is "the department stores, the banks, and the shops" of the town of Port Hope being wasted away. Furthermore, it is not beyond the realm of possibility that in two or three generations this town and others similarly situated may become ghost towns, unless steps are taken soon to control flooding, topsoil washing, and forest denudation.

2. STORAGE BASINS

In the preparation of this report on the Ganaraska river consideration has been given to alternative methods of flood prevention, such as provision of one or more storage basins. Three tentative sites were selected and approximate costs derived from the building of the necessary works. The first of these is near the old settlement of Decker Hollow, on the main branch of the river, the second is located above Osaca and just below the junction of the little Ganaraska and Cold Springs Creek, and the third is on the North Ganaraska above the present pond at

Canton. All dams would be composed principally of earth. It will be noted from the table which follows that these basins have an estimated capacity of 17,500 acre feet[1] for a watershed area about the sites of the dams of 71.3 square miles or 68 per cent of the total drainage area at Port Hope and have an estimated cost of $653,000.00. These costs do not include the provision for roadway diversions and associated damages. The dimensions of the basins and the structures, together with the determination of the corresponding costs, were derived from field observations and approximate contour drawings developed from aerial photographs of the regions, and lack confirmation of instrument surveys. To accurately develop storage basins as a remedial measure of flood control complete surveys are required, together with detailed examination of foundations and exploration for suitable clays and gravel for construction of dams.

STORAGE BASINS

No. Name	Watershed Area, Square Miles	Storage Area, Acres	Capacity, Acre Feet	Storage Head, Feet	Height of Dam, Feet	Cost of Dam and Lands	Cost per Acre, Foot
1. Decker Hollow site (Lot 33, Con 6, township of Hope.	23.1	225	4,000	50	58	$180,000.00	$45.00
2. Osaca site (Lot 28, Con. 6), township of Hope.	18.3	313	7,300	50	58	$270,000.00	$37.00
3. Canton site (Lot 13, Con. 4), township of Hope.	29.9	334	6,200	50	58	$203,000.00	$32.25
			17,500			$653,000.00	

The sizes and costs of these basins are presented as but an indication of the possibilities of this nature of remedy. It is, however, possible that when reliable data respecting the extent of the Ganaraska river floods are available, a substantially less amount of storage would be required with a cost of only a portion of the $653,000.00 above indicated. Notwithstanding this, this lesser cost would probably be materially larger than that for the proposed protective works at Port Hope. It should be borne in mind, however, that in addition to the beneficial effect on flood flows, these storage basins would also be effective in improving low flow conditions.

At this point attention is drawn to the necessity for the collection of hydrographic data in areas where conservation or restoration works

[1]The amount of water required to cover one acre to a depth of one foot: 43,560 cubic feet.

may be contemplated, even though the active operations may not be anticipated for some years. The collection of this data should be undertaken as soon as possible, as the value of this information, in a large measure, depends on the length of the period for which it is available. For the particular area covered in this report it is recommended that gauging stations be established at Port Hope and on some of the river branches, and that one or more wells be made use of for recording the fluctuations in ground water levels.

3. AGRICULTURAL AND WILDLIFE PONDS

The impounding of water in a dozen or more relatively small ponds throughout the watershed should have a beneficial effect on the moisture content of the soil, and thus benefit agriculture and certain types of wild life. It is well known that all soils are more or less permeable, especially sand and gravel. Consequently, when it is recalled that much of the soil of the watershed is of this class, such ponds would do much to increase deep seepage.

In considering such a proposal in connection with a works programme, a number of old dam sites have been examined with this in mind, and three representative ones are listed herewith. However, the scope of the survey did not permit of topographic surveys of the river where all such dams might be located, nor could it include the technical work of deciding on the type of dam and the exact cost of erection. The three suggested are as follows: (1) William Wilson's old dam site on the West Arm of the Ganaraska in the 7th Concession of Clarke; (2) The Comstock site at Kendal; and (3) the Knoxville site in the 6th Concession of Hope.

Measurements have been made of the height and length of these dams and the cost of rebuilding them is estimated to be $6,500.00.

As already referred to elsewhere in the Report, the presence of several dams on the river, all privately owned and therefore under no unified control, may increase the flood hazard under certain circumstances. Therefore, in any comprehensive scheme of water storage and flood control established on the watershed, provision should be made for the control of all dams, both private as well as public, wherever and whenever they influence the flood situation.

CHAPTER NINETEEN

Additional Conservation Measures

1. THE RIVER PROTECTION AREA

THE Ganaraska River Protection Area is intended to serve as a protective fringe along the river and its many tributaries, its purpose being to reduce to a minimum the amount of run-off at certain seasons from bordering agricultural land. Its recommendations are based on the knowledge that the forest is the best protective soil cover, that grasses or pasture come next, and that contour plowing, strip cropping and other improved methods of agriculture are necessary on lands of gentle slope.

[a] The Forest Fringe:

The main stream and tributaries of the Ganaraska River are fairly well protected at the present time with forest, much of which consists of white cedar and other lowland species, as well as some good stands of hardwoods. These areas comprise most of the muck land and bottom soils of the watershed, as well as some of the steeper slopes, and for this reason they have been retained in woodlots and have been used to a certain extent for pasture.

The remedial measures necessary here are the building up of the existing woodland by planting and improvement work, and by the extending of these fringes of woodland where the slope and soil indicate that such work would be most advantageous. In order to give permanency to such work, agreements would have to be made with the owners of the land on which this woodland occurs, and the arrangements would have to be similar to those which have been indicated in the section dealing with the control of other farm woodlots. The amount of woodland included in this fringe along the river is 7,862 acres, of which 5,896 acres require some planting and improvement.

[b] The Control of Farm Land:

In many instances there is considerable run-off into the river from crop land, dried up water courses, and steep slopes. As a control measure on such areas, it is recommended that crop land be brought under modern methods of erosion control, such as contour plowing, strip cropping and

Conservation measures along the river include the planting and care of woodland and improved methods of agriculture where necessary.

other practices; where the slope or quality of the soil is such that cropping is not recommended, that these be placed in permanent pasture; and that all other areas be planted with trees. The delimiting of such areas was not included in the survey made during 1942, and such work would have to be given careful consideration by a soil erosion expert.

The labour involved on the river protection area would be largely tree planting and woodlot improvement. The establishing of permanent pastures, with the exception perhaps of moving fences, would require little extra labour. The work of soil erosion control would definitely require the changing of fence lines and, if terracing is required, such work could be done by men working under the supervision of the soils expert, and using the special types of machinery required, which no one farmer could be expected to buy.

2. RECREATIONAL CENTRES

The desirability of suitable recreational centres in southern Ontario is recognized by all, and certain parts of the Ganaraska Watershed lend

Courtesy of Illinois State Parks.

The erection of log structures in recreational centres would provide a great deal of employment of an attractive kind.

themselves admirably to this purpose. In this report it is not intended to explore to the limit the possibilities of this phase of the work, but three representative sites will be indicated and each will serve as an example of the type of park which could be established.

The first is at the highest point of the watershed in the proposed Ganaraska Forest, at an elevation of 1,285 feet above sea level, and known locally as Tower Hill. The site is reached by travelling east from the Orono-Pontypool road and along the township line. An added educational value could be given by using the forest road through the present Durham Forest, thus compelling visitors to drive to the park through forest plantations of different ages. The park itself would have as its most valuable asset the splendid view which it affords over the watershed, including Lake Ontario which can be seen on a clear day. As the site is on the brow of the morainic hills, such a location would lend itself also for winter sports such as tobogganing and skiing. (See Page 112).

The second is on the Kendal-Campbellcroft road on the township line, and is known locally as Wilson's Bush. This is an area of mixed forest about forty acres in size, on both sides of a branch of the Ganaraska. It contains white pine and hemlock, some of which are a hundred feet high, together with some virgin hardwood. The area has been remarkably free from fire and the grazing of cattle, and is one of the most attractive mixed woodlots in southern Ontario. It is the only area of any size

which would indicate to the present generation what the forests of long ago were like. (See frontispiece).

The third is represented by the large water storage areas and the smaller wildlife ponds. Such parks could be used for campsites and summer cottages, and the ponds could be used for aquatic sports.

The erection of park and recreational buildings at these sites, such as pavilions, rest-rooms, and open fireplaces, using mostly log structures, would provide a great deal of labour of an attractive kind. Such structures were an important part of the programme of the Civilian Conservation Corps, and did much to improve and popularize the State Parks of the Union, as well as other recreational centres.

3. WHITE PINE BLISTER RUST CONTROL

The Ganaraska is largely a white pine site, therefore provision should be made for the planting of this species over a large percentage of the area. However, before this could be done, it must be made reasonably free from white pine blister rust (Cronartium ribicola Fischer). This disease found in Ontario about 1914 has spread rapidly throughout the whole Province. It belongs to the same group as the rust occurring on wheat and its two hosts are the white pine (five needle pines) and members of the botanical family ribes, which includes all wild and cultivated gooseberries and currants.

The accepted method of control of this disease is to search out and destroy all species of ribes growing within infection distance of the pines to be protected. The worst offender is the domestic black currant which will infect white pine to a distance of more than a mile. It has been stated that this species is responsible for starting two-thirds of all the blister rust occurrence where it is found. Sixteen States of the American Union provide for its destruction as a public menace, that is, as a menace to their white pine resources. In Ontario, provision is made for the destruction of this species, as well as others, under the authority of the Ontario Plant Diseases Control Act (R.S.O., Chapter 346), providing the plants are diseased.

The method used in carrying out rust control is to place eradication crews on the area, if ribes are numerous; otherwise, to rely on a system of "scouting". From figures taken from large United States areas of control, the cost of the initial treatment runs from twenty to fifty cents an acre, depending on the local conditions.[1] In the United States some thirty million acres of white pine forest have now been rust-proofed, in whole or in part. Dr. S. B. Fracker, who has had charge of this

[1] J. R. Dickson, "White Pine Blister Rust Control in Ontario as a Post-war Employment," Forestry Chronicle, March, 1943.

The impounding of water in a dozen or more small ponds should have a beneficial effect on agriculture, provide habitat for wildlife, and serve as recreational centres—The old Wilson sawmill, dam and pond on the 9th Concession of Hope.

work states: "We find that control of Blister Rust is entirely practicable and economical . . . that it is possible, by comparison of protected areas with unprotected areas, to be sure that the rust control methods used are proving entirely effective."

As regards the work of this kind to be done on the proposed forest, it should be pointed out that blister rust control to be effective should be extended beyond the precise area which it is intended to immunize. Consequently, it would be desirable to apply rust-control treatment to the part of the watershed above the Kendal-Campbellcroft road, and to the woodland along the river, totalling in all 12,000 acres. The cost of the primary eradication treatment, using an average figure of twenty-five cents an acre, would be $3,000 for 12,000 man-hours.

4. INSECT SURVEYS

In order to enumerate the presence and movement of destructive forest insects of different species on the area, a few men could be detailed to full time work of making collections on the watershed to supplement the records of the Dominion Department of Entomology. Following such surveys, and when serious infestations are reported, additional men could be detailed to combat the outbreak.

5. THE IMPROVEMENT OF STREAMS FOR FISH

Before a systematic programme of restocking can be planned, a careful study must be made of all the factors relating to the suitability of the streams for fish of different species by an expert trained in this work. Such a study should be concomitant with other remedial measures pro-

posed. When such information has been secured, work could be done in the improvement of streams for this purpose, such as the building of fish ladders at dams, rest dams in the small branches, and in the planting of young fish where required.

6. MAPLE SYRUP

Throughout the existing woodland on the proposed forest there are many stands of maple, some of which could be tapped for sap. While it is impossible to estimate what the yield of this would be in gallons, nevertheless such a harvest could be used at least to supplement the commissariat of the work parties.

7. WINDBREAKS ON HIGHWAYS

In recent years throughout the province permanent snow fences of trees have been planted on highways, to take the place of the lath type of fence so commonly used. It has been shown that apart from increasing the attractiveness of the highways, such fences or windbreaks would pay for themselves in a few years. Sixty-six miles of provincial highways traverse the watershed, besides other crossroads maintained by the county. Many sections of these could be improved in this way.

8. TREE PLANTING ON HIGHWAYS

The benefits of tree planting and landscaping on the main highways have received much attention from the Ontario Government, not only because of their intrinsic worth, but also because of the added attraction to tourists visiting the province. Many hours of worthwhile labour could be done by a trained group of men carrying out a programme of this kind on the highways of the watershed. Seventy-five miles of such planting could be carried out.

9. COLLECTION OF TREE SEED

As already mentioned under reforestation, any large scale programme of this kind requires a good supply of seed. The watershed is a fruitful source for many of the species used, especially white pine. Large quantities of this species and other conifers, as well as hardwoods, could be gathered each fall when the crop is worthwhile.

10. NURSERY PRACTICE

Also in the work of reforestation, which is a major project of the conservation measures, a large supply of planting stock is needed. To

U.S. Forest Service photo.

Work could be done on the streams, such as the building of fish ladders at dams, rest dams in the small branches, and the planting of fish where required.

assist in this it would be feasible to have men from the project supplement the labour at the Orono Nursery during busy seasons of the year It would be practical, also, to use some of the better farmland in the Ganaraska Forest as a transplant nursery to supplement the supply at Orono. This could be managed under the direct supervision of the Superintendent of that Nursery.

11. MISCELLANEOUS WORK

Besides the projects mentioned above, there are other types of work which could be carried out. Some of these are as follows: bridge and culvert building; telephone line construction; fire detection towers; camp sites and fireplaces other than in the specified park areas; the cleaning and restoring of springs; forest foot trails; removing old buildings; the protection of stream banks; harvesting ice from established ponds; and the erecting of historical monument sites.

TABLE SHOWING TYPES OF WORK AND COSTS

1. GANARASKA FOREST

Page	Type of Work	Units	Trees	No. per acre	Unit Cost	Man Hours	Money	Remarks
195	Site clearing	6,497 ac.	4,000	.....	8 hrs.	32,000	$8,000.00	Includes cutting into cordwood and brushing.
196	Open land planting (Conifers)	6,497 ac.	6,497,000	1,000	$5.75	149,431	37,357.75	Includes furrowing.
198	Open land planting (Hdwds.)	1,500 ac.	4,083,000	2,722	$8.00 per ac.	48,000	12,000.00	4x4 spacing; 1,500 acres listed as crop land.
198	Erosion planting	1,426 ac.	3,881,572	2,722	$10.00 per ac.	57,040	14,260.00	Includes some brushing.
199	Erosion check dams	360	.....	.....	16 hrs.	5,760	1,440.00	Not including material.
199	Woodland improvement	4,687 ac.	.....	.....	60 M.H. per ac.	281,220	70,305.00	Represents thinning 75% of total woodland and brush disposal.
197	Woodland planting	4,687 ac.	4,687,000	1,000	$5.00	93,740	23,435.00	Represents planting of 75% woodland.
200	Plantation pruning	767 ac.	.....	.....	32 hrs.	24,544	6,136.00	Includes brush disposal.
200	Plantation thinnings	146 ac.	.....	.....	24 hrs.	3,504	876.00	Includes brush disposal.
201	Boundary fence	12,160 rods	.....	.....	$1.00	24,320	6,080.00	Rebuilding one-half only.
201	Removing interior fences	31,040 rods	.....	.....	.25	31,040	7,760.00	
201	Road and trail building	10 miles	.....	.....	360 M.H.	3,600	900.00	
202	Fire guards	8 miles	.....	.....	160 M.H.	1,280	320.00	Interior fire guards only.
	TOTALS		19,152,572	.....		755,479	$188,869.75	

2. MUNICIPAL AND PRIVATE FORESTRY

205	Open land planting (Conifers)	1,343 ac.	1,343,000	1,000	$5.75 per M.	30,889	$7,722.25	One half total area.
205	Erosion planting	306 ac.	832,932	2,722	10.00 per ac.	12,240	3,060.00	Includes some brushing, spacing, 4x4.
208	Woodland improvement	625 ac.	.....	.....	60 M.H. per ac.	37,500	9,375.00	50% of woodland.
208	Woodland planting	625 ac.	625,000	1,000	$5.00 per M.	12,500	3,125.00	
208	Plantation pruning	170 ac.	.....	.....	32 M.H. per ac.	5,440	1,360.00	Includes brush disposal.
	TOTALS		2,800,932			98,569	24,642.25	

TABLE SHOWING TYPES OF WORK AND COSTS—Continued

3. FLOOD CONTROL

Page	Type of Work	Units	Trees	No. per acre	Unit Cost	Man Hours	Money	Remarks
213	Storage basins	3				365,400	$91,350.00	Labour only, 45% of total cost Canton site.
211	Improvements at Port Hope					200,000	50,000.00	Labour only.
	TOTALS					565,400	$141,350.00	

4. ADDITIONAL PROJECTS

(a) The River Protection Area

215	Open land planting (Conifers)	2,805 ac.	2,805,000	1,000	$5.75 per M.	64,515	$16,128.75	Includes furrowing.
215	Erosion planting	394 ac.	1,072,468	2,722	10.00 per ac.	15,760	3,940.00	Includes some brushing.
215	Woodland improvement	5,896 ac.			60 M.H.	353,760	88,440.00	75% of total acres.
215	Woodland planting	5,896 ac.	1,768,800	300	$5.00 per M.	35,376	8,844.00	75% of total acres.
	TOTALS		5,646,268			469,411	$117,352.75	

(b) Other Projects

216	Recreational Centres	3				12,000	3,000.00	
218	Blister Rust Control	12,000 ac.			.25c. per ac.	12,000	3,000.00	
219	Insect Surveys					5,568	1,392.00	
214	Ponds for Wild Life	3				26,000	6,500.00	
219	Restocking Fish					864	216.00	
220	Windbreaks on Highways	66.25 miles	71,000		$500.00 per mile	132,500	33,125.00	One row of trees.
220	Tree Planting on Highways	75 miles	5,280		$1.25 per tree	26,400	6,600.00	75 feet apart.
220	Seed Collecting					3,000	750.00	
220	Nursery Practice					13,920	3,480.00	
221	Miscellaneous					15,000	3,750.00	
	TOTALS		76,280			247,252	$61,813.00	
			27,676,052			2,136,111	$534,027.75	

CHAPTER TWENTY

Conservation Measures in Progress

THE necessity of using the submarginal land on the Ganaraska for worthwhile purposes has long been under consideration by many citizens who have the county's future at heart. and during recent years some progress has been made in this regard. This has consisted of the reforesting of waste land on private property, projects undertaken by townships and the United Counties, and demonstrations of woodlot management.

In discussing the reforestation work on this area, it is interesting to note that the first forest plantation in the Province of Ontario, under the scheme of free distribution to farmers by the Government, was established by Frank L. Squair in 1905, in Darlington Township, on Lot 7, Concession 3, just over the boundary of the watershed. This early plantation attracted considerable attention in this part of Ontario, and throughout the years has been a splendid demonstration and inspiration to those planning similar work.

The plantation was established at the time reforestation was inaugurated in the Province and the policy of the Government at that time until the present, with few slight variations, has been the same, namely, that private land owners can secure trees, without cost, for reforestation work, by paying transportation charges from the nursery to their nearest railroad station. During three or four years in the 1920's, the quantity supplied to any one person was limited to 3,500, with quantities in excess of this being sold at the rate of $4.00 per thousand. Since that time this limitation has been removed, so that anyone can secure as many trees as he cares to plant in any one year. Several land owners in the area have taken advantage of this free distribution, and have planted trees chiefly for the control of wind erosion and the utilization of non-agricultural land.

Most of the planting work has been done by farmers, who have used the trees for protecting their own properties, and in the case of some who had a larger acreage than the average owner and considerable light land, good sized plantations have been established. Other plantings are on areas which have been purchased by non-residents, for the specific purpose of growing timber. There are a few excellent plantations of this

type on the area. However, in this connection it should be pointed out that in many cases—too many in fact—where work of this kind should be done and where it would be a decided advantage to the land owner, the owner or occupant is in such a poor position financially that he has not the incentive or the will to help himself.

One township included in the area has done some planting. This work comes under the heading of demonstration plots and was carried out under the policy which was laid down by the Government in 1922, when it offered to assist municipalities in the establishment of small forest plantations for the purpose of demonstrating the use of trees on marginal or submarginal land. To meet the requirements for such a plot the Government required that the area be on a well-travelled road so that as many people as possible could see it; that the municipality either purchase land or use land which was in their possession; fence it, and agree to give the area reasonable protection after planting. In return, the Government agreed to supply the trees, pay the cost of planting, and of supervising the work when the planting was in progress. In 1932, when Government funds were curtailed, the policy governing these demonstration plots was changed and, from that time to the present, the Government has not paid the cost of planting, although the other conditions governing the establishing of these plots have remained the same.

Under this policy the Township of Clarke established two plantations. The first is on Provincial Highway No. 35 from Newcastle to Lindsay, five miles north of Orono on Concession IX, Lot 24, and adjacent to the Enterprise Public School. It consists of ten acres of sandy, hilly land and is situated excellently for demonstration purposes. It was established in 1925 at a cost of $100.00 for land and of $75.02 for planting.

A second plot was established on the morainic slope in Concession IX, Lot 7, and consists of badly eroded sand land in the centre of a large area of this type. It contains twenty-five acres and was established in 1939. The cost of the land was $20.00, and of fencing $90.00, or a total of $110.00. The planting costs of this area are of no value as a basis of comparison as it was planted with relief labour.

In 1922, the present policy of county forests was laid down. This work is done under the authority of the Counties' Reforestation Act (R.S.O., Chap. 323), which lay dormant from 1911 until the above year. The Act provides for the purchasing of land and the entering into agreements by the county for the management of such lands. No limit as to the size of the area is stated, so that some counties have plots of a few acres, while others have forests of several thousand acres. If, however, a county wishes to enter into an agreement with the Minister of

Lands and Forests for the planting and management of such county owned land, the policy has been that the county must purchase not less than one thousand acres. The agreements which are in force at the present time run for a period of thirty years, during which time the Ontario Government agrees to establish the forest, and pay the costs of such items as fencing, buildings, equipment, labour, maintenance, trees, etc., in short, everything connected with the management of the forest.

At the end of the thirty-year period, the county has the privilege of exercising one of three options: *First*, to take the forest over from the Government and pay back the cost of establishment and maintenance from the beginning to the end of the thirty years, without interest; *Second*, to relinquish all claim to the forest, whereupon the Government will pay back to the county the cost of the land, without interest; *Third*, the forest may be carried on as a joint undertaking by the province and the county, each sharing half the cost and half the profits.

It will be seen from the above summary of the agreement that all a county stands to lose on such a project is the interest for thirty years on the purchase price of the land. Also, it should be pointed out that, in drawing up such a liberal scheme, it was done purposely to encourage the reforestation of waste land and to get some large areas underway, so that private individuals would see the effects of this work and carry out similar projects of their own. Again, it was not the original intention of the Government to have the counties stop at a minimum of 1,000 acres, as the overhead necessary on an area of this size could very easily be spread over an area of five, or even ten times the size. As a matter of fact, this is what has happened in some counties where the councils have initiated a progressive reforestation policy.

The United Counties of Northumberland and Durham established a forest in Northumberland County in 1924, on the Cobourg-Hastings road. The total acreage in this forest at the present time (1939) is 1,141 acres, and cost the United Counties $5,920.00, or $6.16 per acre. In 1928 the United Counties established a second forest in Durham County on the 10th Concession of Clarke, which is on the border of the northern boundary of the watershed. The land which is included in this forest is on the moraine and is typical of much of the land in the area. It contains (1941) 1,074 acres and cost the Counties $9,561.00, or $8.90 per acre. The Durham Forest has demonstrated adequately the use of this type of land for reforestation work, but the area included represents a very small percentage of the total area which should come under such management.

Demonstration woodlots are privately owned areas of woodland on which the owners have agreed to follow prescribed methods of woodlot

The Orono Nursery of the Department of Lands and Forests, situated on the 5th Concession of Clarke—just west of the watershed—is the chief distributing centre for reforestation stock for eastern Ontario, and is the headquarters of the Zone Forester.

management outlined by the Department of Lands and Forests, and to permit access to the area by interested persons. These areas are indicated as such with a large sign and inspected annually by an officer of the Department. Such demonstration woodlots, and the influence they exert on the proper management of similar areas in the township contribute to the total conservation effort of any area but are not directly related to the reclaiming of submarginal or marginal land. There are three demonstration woodlots on the watershed.

It will be seen from the foregoing that conservation work which has been carried on up to the present on the area cannot hope to solve the problem of reclaiming all the submarginal lands on the watershed, especially in view of the fact that the survey shows an area of 31,143 acres either in forest or suitable only for tree growth.

In the discussion of conservation measures to date on the area, mention should be made of the Provincial Forest Nursery at Orono, established in 1922. This is centrally located in Durham County on Highway No. 35, on the outskirts of the village of Orono, four miles north of Provincial Highway No. 2. It is the main distributing centre for reforestation stock in eastern Ontario and, in addition to providing in-

formation regarding problems connected with conservation, it contains a number of excellent demonstrations of forest planting of different species and mixtures. Yet in spite of the help which is provided at this station for the people of this part of the province, it would appear that they have not taken advantage, to the fullest extent, of the assistance which is at their very door, but have lagged both as individuals, and certainly as municipalities, in the rebuilding of their countryside, where the stabilizing influence of forest cover is most urgent.

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ADMINISTRATION

Dominion Forest Service photo

"Build for the future; let thy children say
'His mind was finely toned and firmly set:'"

CHAPTER TWENTY-ONE

Land Acquisition

THE problem of land acquisition in any part of agricultural Ontario, where practically all the land is privately owned, is one which requires careful approach. The ownership and use of land, especially for agricultural purposes, is considered by most citizens as one of their few remaining inalienable rights. However, where the good of the whole community is under consideration, such personal rights should be, and have been, overruled under the principle of eminent domain. Examples of such cases are the building of highways, the construction of power lines, and the acquiring of land for military purposes in the event of a national emergency.

In southern Ontario, compulsion has not been exercised to any great extent by the Government in planning proper land use schemes. But who would gainsay the fact that the acquiring of poor land on the upper Ganaraska for conservation purposes does not constitute a national emergency, and therefore requires a more permanent authority than the individual to bring it back to its proper use?

However, in dealing with land acquisition, it should not be the desire of any authority to approach the problem in a dictatorial manner. It will require careful handling, and as a preliminary step in such work the people of the area should be acquainted with the purpose of the scheme, its ultimate benefits to the community, and by explanation and demonstration be gradually brought to the point where they will be glad to co-operate.

The only part of the Ganaraska where large scale transfers of property from private ownership to a forest authority would have to be made is that section on which it is recommended that a protection forest be established. In the chapter dealing with soils, it is clearly indicated that a large percentage of this area is in the marginal or submarginal class and, as indicated in the chapter on Economic Aspects of Agriculture in the area, in many instances farming and living conditions are difficult to maintain. In fact, "The average level of living of thirty-three farmers in the proposed forest area is lower than for the rest of the watershed, and for a good many farms the level is so low that insufficient necessities are obtained, and almost nothing in the way of advancement goods and recreation, which are considered as part of the Canadian level of living."

It is true, of course, that there are a few farms in the area which are as good as many lower down the watershed, but in any large area of poor land on which some agriculture is being practised, this might be the case. However, it is not essential that the best farms be withdrawn entirely from agriculture, but an arrangement could be arrived at so that such farms, where the upkeep of public utilities is not too heavy, could be retained as agricultural land. Such areas could be incorporated into the forest as farm land, and be used by forest workers for this purpose; the farm work and forest work going hand in hand; one supplementing the other at different seasons of the year.

1. METHODS OF ACQUIRING LAND

There are several ways in which land can be acquired and controlled for conservation purposes, and it is proposed to enumerate and discuss these briefly in this section.

[a] Transfer by Private Sale:

The most satisfactory method of acquiring land is by private sale between the forest authority concerned, and the land owner. This method has been followed by the counties of Ontario in purchasing land for reforestation work in building up the system of county forests, which totals, in round figures, 25,000 acres. This method has its drawbacks, however, as individuals who have not the community's welfare at heart, or for one reason or another have an exaggerated idea of the value of their property, may block the completion of a unified area by refusing to sell. This was overcome in the State of New York, where over 450,000 acres of land have been purchased for reforestation, by refusing to buy individual parcels of land unless there was a sufficient number in a group to make a contiguous block of 500 acres.

[b] Maximum Price per Acre:

Another method which has been used has been to fix a maximum price per acre for this class of land, beyond which the forest authority is prohibited to go; allowance being made for the presence of good fencing and buildings on the properties, which in some cases have been removed by the vendors and allowed as part payment for the land.

[c] Agreements:

Where owners of property prefer to retain their woodlots, or where parts of farms fall within the forest area prescribed, and providing the retaining of ownership does not jeopardize the complete conservation scheme, agreements could be made for the control and management of such areas.

This method has been adopted by the Dominion Forest Service in Nova Scotia, where it has been desirable to control wooded areas for experimental and conservation schemes, and in this particular case the agreements cover a period of twenty years.

In Ontario there is one example, at least, where a municipality leased a part of a farm for reforestation work for fifty years, and one United Counties' council has adopted the plan of taking easements on land for the same purpose.

[d] Control by Existing Legislation:

Under the authority of the Private Forest Reserves Act (R.S.O. 1937, Chapter 324), the Minister of Lands and Forests, on recommendation to the Lieutenant-Governor in Council, may, with the consent of the owner of any land covered with forest or suitable for reforestation, declare such an area to be a private forest reserve. When such an arrangement is made, the Minister, or his representatives, may reforest such areas, supervise the improving and cutting, and prohibit the removal of trees by the owner without his consent, and also prohibit the grazing of the area by cattle.

[e] Life Lease:

Many of the farms on the proposed forest, as already mentioned, are of low agricultural worth and are supporting families at the present time. The problem in such cases is not so much the purchase of the property, as what will become of the family after the farm is acquired. In almost every case it would be impossible for the vendor to purchase another farm with the money he receives, except one which is of approximately the same value, outside the forest. In some cases such farms are occupied by older people, whose families have grown up and left the community. The removal of these from their properties might work undue hardship on them, and in fact in some cases they might become a burden on the municipality. With some of these, the plan of giving the vendor a life lease would be sufficient. In most cases such old people make little attempt at farming the whole property, but require only sufficient pasture for a cow or two, enough land for a garden, the house and buildings; and a supply of fuelwood. The plan of giving a life lease has been adopted in the case of two properties,[1] at least, on the county forests in Ontario, and has proved satisfactory to both contracting parties.

[f] Tax Delinquent Land:

Under the Statutes of the Province of Ontario,[2] land which becomes tax delinquent is sold by the County Treasurer. In the case of farm

[1]Northumberland Forest and Angus Forest.
[2]R.S.O., c. 272. Sec. 148.

land this is not done in practice until the land has been in default for three, or in some cases, four years. Even then the owner has the privilege of redeeming his property within a year. Where such lands are marginal or submarginal, they are sometimes bought only for a part of the area which is of special value, such as woodland, old buildings, or a good field or two. In some instances the poor land remains idle and frequently appears again at the tax sale. The fact that such land becomes tax delinquent is an indication in many cases that its ultimate use is forestry. Under the present Statutes the municipalities are not permitted, at the first sale at least, to acquire or reserve such land for conservation purposes. Consequently this report recommends that all tax delinquent land should come under the review of a local committee, composed of the Zone Forester, the Agricultural Representative, and the Chairman of the Reforestation Committee of the County, and if, in the opinion of this Committee, such land is of value for conservation purposes, the local municipalities should have the first opportunity of purchase.

[g] Expropriation:

As a last resort in land purchases, or where the owners of abandoned land cannot be located, such areas can be acquired by expropriation. The Forestry Act (R.S.O. 1937, Chapter 39, Par. 2) states:

"The Minister (of Lands and Forests) may, for and in the name of His Majesty, lease, purchase, or acquire, and subject as hereinafter mentioned, may without the consent of the owner thereof enter upon, take and expropriate any land in Ontario which the Minister may deem necessary for forestry purposes."

Also, under the same Act, Par. 13, provision is made for the removal of settlers from lands unsuitable for farming. To quote:

"Whenever in the opinion of the Minister, it is found that settlement has taken place on lands not suitable for agricultural purposes, and which said lands are required for forestry purposes, the Minister shall have power to make arrangements for the removal of such settlers upon such terms as may be agreed upon."

As a matter of general interest, it should be stated that this Act also provides for the power to close roads on lands taken over for forestry purposes, the setting apart of lands for settlement, and the removing of settlers from lands unsuitable for farming. It should also include, however, provision for acquiring permanent or community pastures, and pondage areas, where these are required, as an integral part of a large conservation project.

2. COST OF LAND IN THE PROPOSED FOREST

It would be impossible to give an accurate figure for the total purchase price of all land in the proposed forest without consulting the owners of the individual parcels. However, as an indication for arriving at the approximate cost, the amounts paid by the several counties of the Province in purchasing land for their forests will serve as a guide.

TABLE SHOWING COST OF LAND PURCHASED BY PRIVATE SALE FOR COUNTY FORESTS

Name of Forest	Owned by County of	Acres	Cost	Cost per Acre
Augus	Simcoe	991	$5,639.75	$5.69
Dufferin	Dufferin	1,077	7,945.32	7.37
Durham	Northumberland and Durham	1,074	9,561.00	8.90
Grey	Grey	463	2,896.00	6.25
Hendrie	Simcoe	2,250	13,921.04	6.18
Larose	Prescott and Russell	1,725	8,180.00	4.74
Northumberland	Northumberland and Durham	960	5,920.00	6.16
Orr Lake	Simcoe	2,319	14,589.25	6.29
Tosorontio	Simcoe	600	3,300.00	5.50
Uxbridge	Ontario	975	9,050.00	9.28
Victoria	Victoria	1,715	5,061.00	2.95
Vivian	York	1,174	19,516.00	16.62
Au Sable	Bruce	1,484	4,177.94	2,81
Totals		16,807	$109,757.30	$6.53

In the above table a cross-section of land costs for some of the county forests will be found. Lanark and the United Counties of Leeds and Grenville are not listed as the land for these was not purchased by private sale. Norfolk and Peterborough Counties, which have a large acreage in their forests, do not come under the county forest agreement. It should be pointed out, too, that the acreage listed under each forest does not represent the total acreage of that forest to date, but only a part of it which was purchased by private sale. Of the remaining land making up the total acreage on the different forests, some was tax delinquent and was therefore purchased at a low figure, some was purchased from the Crown at a nominal sum, while for the remainder the particulars regarding area, cost, and nature of purchase, have not yet been listed with the Department.

It will be seen from this table that the properties which are nearest to the proposed forest, namely Durham Forest, which is within the area, and Northumberland Forest, which is thirty miles due east, cost respectively $8.90 and $6.16 an acre, or an average of $7.53 an acre. While this is a dollar higher than the average for the Province, it is a fair price

for the land purchased, because at least one-third of it was in woodland, and some of the parcels were being used for farming up to the time of transfer.

Another indication of the value of any property is its assessment. The percentage of the value on which this is based varies in different townships, but the accepted rule in the United Counties of Northumberland and Durham is approximately two-thirds of the actual value. The total assessed value of all taxable land in the two townships, for the 19,700 acres included in the proposed forest, is estimated at $121,500, averaging slightly more than $6 per acre. On the basis of two-thirds of the value, this would amount to $9.25 per acre, or $182,250 for the whole forest.

CHAPTER TWENTY-TWO

Supervision

1. COST OF WORK PROJECTS

IN dealing with the cost of work projects, the most satisfactory method is to select a convenient unit for which costs are available, and use this as a guide in estimating the cost of a single project, or as many others as might be planned.

The most extensive programme which has been undertaken to date, in which work done is comparable to that which is required on the Ganaraska, is that of the Civilian Conservation Corps, conducted by the United States Government from 1933 to 1942,[1] which had an enrolment at one time of 322,000 men. Complete cost figures are available for this undertaking and will serve as a guide for costs in this report.

The average cost of a typical C.C.C. project, covering buildings and utilities, ran on an average of $25,000 per project for 200 men, throughout the life of the C.C.C.

The normal group of buildings in a set-up were: sleeping quarters, usually five, for 200 men; a mess hall for the same number; a recreation or welfare building, usually 20′ x 100′; a school building 20′ x 70′; baths and latrines for the same number; a dispensary or infirmary, usually 20′ x 30′; a supply room and headquarters for administrative personnel, either one 20′ x 70′ building, or a 20′ x 30′ headquarters and a 20′ x 40′ supply room. Then there was the same structure or two structures for the office and supply rooms of the technical or project personnel. To this was usually added a shop for the minor repair of technical service tools and automotive equipment and three, four, or five truck sheds to house the vehicles; a small house, usually 10′ x 20′, for lubricating oils, greases, etc.; and finally, if a well and small light plant were used, there was a pump or utility house, 20′ x 20′. This layout was installed at the average cost mentioned above. The buildings were usually constructed of No. 2 pine with tar paper roofing.

The usual automotive layout in a standard C.C.C. camp was three ½ ton pickup trucks; eight 1½ ton stake trucks, and other vehicles as the nature of the project required.

The positions such as cooks, mess steward, company clerk, technical service clerk, first-aid assistant, assistant educational advisor, supply clerk,

[1]Costs and other data supplied through the courtesy of the Director of the Civilian Conservation Corps, Washington, D.C.

etc., were all filled by enrollees. The normal operating overhead for such a project was twenty-five, thus leaving from 160 to 170 men for field work.

The staff at these projects was divided into two groups, namely, the administrative staff, which was responsible for equipment, discipline, and regular operating routine; and the technical staff, which planned the actual work and supervised it in the field. The administrative staff consisted of four members, including a physician, while the technical staff included a superintendent and assistant and from five to eight foremen.

Using the above figures as a basis, and adding the other necessary items, the cost for a single unit on the Ganaraska would be as follows:

Cost of Conservation Project for 200 men (25 staff, 175 workmen) for one year:

(It is presumed that item 1 could be reduced considerably, or possibly eliminated, providing such equipment as sleeping quarters, bedding, cookery, and trucks, were made available from the army after the war. An item of approximately $5,000.00 would have to be allowed, however, to take care of the change-over.)

1. Sleeping quarters, office and stores, buildings, tools, cookery, trucks, etc.	$25,000.00
2. Salaries of staff (25)	30,000.00
3. Wages of men (175 men at $2.00 a day for 312 days)	109,200.00
4. Food (200 men at 75c a day for 365 days)	54,750.00
5. Gasoline and miscellaneous	5,000.00
	$223,950.00
Less (item 1, $25,000.00)	198,950.00
Cost of change-over	5,000.00
	$203,950.00

Using the round figure of $200,000.00, the cost per man per year would be $1,000.00.

2. SUPERVISORY TRAINING

Considering the number of men who could be employed on the Ganaraska, and remembering that such a project is only one of several conservation schemes that should be undertaken after the war, the procuring of a supervisory staff, both as regards technical assistants and

works foremen, should be given early consideration. Providing plans are ready for one or more projects at the time of cessation of hostilities, provision should be made for the immediate training of supervisors. These plans should include the establishing of a training school, in surroundings where field work of different types could be demonstrated. Such a school might be modelled after the ranger schools which have been conducted for several years by the Quebec Forest Service and the Commission of Conservation of the State of New York. In this case, however, the curriculum and field practice would have to be suited to the type of work included in a conservation scheme.

This school would not take the place of university training for technical men but would be primarily for the training of foremen and men to help do investigative work. Technically trained men, as required, would have to be drawn from the universities. Many such men are now serving in the Armed Forces and these, as well as others capable of filling positions of responsibility, could be released from active service and repatriated as soon as possible, when peace is declared, in order to commence the course of training which is essential for carrying on extensive conservation projects.

3. FUTURE MANAGEMENT

Conservation projects, unlike some other post-war work, must include a plan for permanent management. The most obvious solution would be to have these administered by the department which initiates the project, but as has already been shown in outlining the different types of work included in a complete land rehabilitation scheme, no one department is equipped at present with a staff of experts trained in all the sciences represented. Even if a department were so equipped, it is questionable whether the best interests of the community would be served by having a government department take absolute responsibility for such a programme. In the opinion of those responsible for this report, it would be more effective if such a programme could be permanently supervised under a partnership arrangement in which the federal and provincial governments, the municipalities, and the private land owners are represented. This plan of control has been adopted in part in Ontario by the Grand River Valley Conservation Commission, and several examples of such control are found in the United States, the most outstanding being the Muskingum Conservancy District in the State of Ohio.

[a] Grand River Valley Conservation Commission:

The Grand River Watershed is located in east central Ontario and

has an area of 2,600 square miles, only 5 per cent of which is wooded.[1] Commencing near the town of Dundalk, it runs for the most part through a good agricultural section of the Province, passing through the towns of Waldemar, Grand Valley, Fergus, Elora, Preston, Galt, Paris, Brantford, Caledonia, Cayuga, Dunnville, and Port Maitland, where it empties into Lake Erie.

For many years the damage done by floods along the Grand River has been considerable, in spite of protective works which have been built to hold them in check. However, flood conditions in the spring have not been the only concern of these municipalities, but just as serious has been the lack of sufficient water in the river during summer months to provide for municipal purposes, particularly sewage disposal.

In 1931 the Grand River Valley boards of trade, representing the municipalities along the valley, petitioned the Ontario Government for a solution of the problem. Accordingly a survey was made by the Hydraulic Department of The Hydro-Electric Power Commission of Ontario, and the Division of Surveys of the Department of Lands and Forests. From the facts presented by this survey, an Act was passed by the Provincial Legislature in 1938, known as "An Act to provide for the conservation of water in the Grand River Valley." (2 George VI, Chap. 15, Par. 8.)

The salient features of this Act provide for the establishment of a commission to be known as the Grand River Valley Conservation Commission, which shall be a body corporate appointed by the councils of the participating municipalities. According to the Act this Commission shall have authority:

(a) "to study and investigate, itself or by its engineers, or other employees or representatives, the Grand River Valley and to determine a scheme whereby the waters of the said Grand River Valley may be conserved to afford a sufficient supply of water for the municipal, domestic and manufacturing purposes of the participating municipalities during periods of water shortage and controlled in times of flood, and to undertake such scheme;

(b) "to erect works and create reservoirs by the construction of dams or otherwise;

(c) "to acquire land and other property, real and personal, for such purposes as the Commission may deem necessary for the carrying out of any scheme and sell or otherwise deal with such land or other property;

[1]Report on Grand River Drainage, 1931, by James Mackintosh. Department of Lands and Forests, King's Printer, Toronto.

(d) "to enter into such agreements for the purchase of materials, employment of labour and such other purposes as may be necessary for the due carrying out of any scheme;

(e) "to determine the proportion of the total benefit afforded to all the participating municipalities which is afforded to each of them; and

(f) "generally to do all such acts as are necessary for the due carrying out of any scheme."

The method of financing the project is set forth as follows: (Par. 32)

(1) "For the purpose of paying costs of maintenance, including maintenance of the works included in any scheme, office expenses and salaries, a sum may annually be levied by the Commission against each of the participating municipalities."

Up to the present this Commission has erected a large dam on the main river, just above the town of Fergus, which provides a lake seven miles long and over two miles wide, with a pondage area of 46,000 acre-feet. This dam has already been very effective in preventing disastrous floods on the lower river, and in storing water for summer flow. The Commission also has plans for other dams farther up the river and contemplates using the lakes created by these for recreational purposes.

The Federal and Provincial Governments each paid 37½ per cent of the cost of the construction of the Fergus dam. The municipalities paid the remaining 25 per cent and now pay all maintenance costs. The following is a breakdown of the anticipated total cost submitted in May, 1943:[1]

Construction	$1,288,057.10
C.P.R. Diversion	347,409.26
Road Construction, closures, etc.	22,738.56
Engineering	84,008.42
Legal	15,030.55
Land Purchases, less receipts of $15,901.69 for salvage	263,768.78
Administration, current, operating and miscellaneous	25,474.34
Reforestation	10,000.00
	$2,056,487.01

[1]From correspondence with E. F. Roberts, Secretary-Treasurer, Grand River Conservation Commission.

[b] The Muskingum Watershed Conservancy District:

The Muskingum River, which empties into the Ohio River, drains a watershed of 8,000 square miles, an area as large as the whole of south-central Ontario. The watershed had been farmed for several generations until, in the last four decades of the past century, floods became increasingly serious. In 1898 flood waters reached a record high of 36.8 feet at the City of Zanesville, and in March, 1913, after a heavy rainfall which lasted for several days, the river rose to a new high of 51.8 feet. The main river and many of its tributaries overflowed their banks and deluged the countryside, causing much loss to property. The following summer a drought occurred, which ironically contrasted the abundance of spring water with the lack of summer water. Following this a group of public-spirited citizens on the watershed set in motion a movement to alleviate, if possible, flood conditions and resulting destruction on the area. Accordingly, the Muskingum-Tuscarawas Improvement Association was formed, which represented all parts of the watershed. Through the efforts of this association the Ohio Department of Public Works in 1930 was persuaded to make a preliminary investigation of the entire Muskingum drainage area. In this survey all features relating to the use and control of waters of the drainage basin were covered, and as a result of the survey it was shown that a flood control and conservation programme for the area was practical, and would materially reduce floods on the area and also flood crests on the Ohio River itself. The estimated cost of the recommended control measures, however, was too great for the local units to bear, therefore it was decided to appeal for assistance to the State and Federal Governments.

A petition was then presented to the State Legislature which in 1912 had amended the Constitution to provide for the passing of laws on conservation, and subsequently, in 1914, had enacted the Conservancy Act of Ohio, which authorized the creation of conservancy districts within the State. This Act is said to be the model of its kind in America and permits the organization of conservancy districts "with the power to plan, construct, maintain and administer flood control and conservation projects." The Act also gives the conservancy district the right of eminent domain, provides machinery for financing, and the authority to make contracts with Federal and State Governments, and individuals. On June 3rd, 1933, the Muskingum Watershed Conservancy District was created, as a perpetual public corporation; its purposes being flood control, water conservation, soil erosion control, and the development of the uses of water incident thereto.

The different projects which have been completed up to the present time, and others which are being carried on, are as follows; Fourteen flood control reservoirs, together with the necessary dams, have been built.

These reservoirs provide a total capacity of 1,539,200 acre-feet. A number of the lakes created are being used for recreational purposes and the development and conservation of wildlife.

The United States Soil Conservation Service, with the assistance of the C.C.C., undertook an extensive soil conservation programme, which had for its main purpose the placing of the steepest slopes and land which had been badly eroded, back into forest; the placing of less steep slopes, where it was considered necessary, into permanent pasture; and modern methods of contour plowing and strip cropping on areas of gentle slope. The extensive programme undertaken by the Soil Conservation Service called for demonstration areas, advice to farmers on their own land of the proper method of tilling; the supplying, where necessary, of seed grain and special types of grasses; and the establishing of a nursery for the production of trees, shrubs, grasses and vines. By 1937 over eleven million trees and shrubs of different species had been supplied.

The programme also called for the establishing of necessary research work in the fields of soil conservation, hydrology, weather, climate, physiography, glacial history and historical research. Much of this work has been done in conjunction with the Ohio Agricultural Experiment Station and the Ohio Agricultural Extension Service which includes on its staff, soil conservationists, soil technologists, foresters, engineers, agronomists and biologists.

The whole scheme has been financed by grants from the Federal and State Governments, and by taxes on the properties within the area which benefit from the flood control and conservation measures.[1]

[c] Conservation Projects in Ontario:

It will be seen from the two conservation projects outlined above that they have many features in common; the chief difference, however, being that the Ohio project not only built dams which were urgently needed, but carried on immediately with other problems such as soil erosion control and the protection of the headwaters of the river by reforestation and the planting of shrubs.

Both these projects were initiated by the people who were definitely affected by conditions on the watershed, and which were periodically becoming more serious. The method used in solving the problem, and particularly the method of local supervision adopted, is worth consideration for similar projects in southern Ontario. It is felt by those who have worked for years in the rural communities of Ontario, that if the

[1] From publications and data kindly supplied by Bryce C. Browning, Secretary-Treasurer, Muskingum Watershed Conservancy District, New Philadelphia, Ohio, U.S.A.

A plantation of Red Pine (Pinus resinosa) thirty years of age, on light land at the St. Williams Nursery, Ontario. The establishing of such plantations not only provides healthful outdoor work, but also valuable returns in the future.

people who require definite help in some problem can give assistance in solving that problem and supervising the work once it is started, the undertaking will be much more successful.

This present report recommends that legislation be enacted in Ontario combining the best features of the Grand River Valley Conservation Commission, and the Muskingum Watershed Conservancy District, so that conservation projects on needy areas may be initiated immediately after the necessary local requirements of the Act are complied with by the municipalities concerned.

4. FUTURE RETURNS

Very little has been said regarding future returns from a conservation programme such as is described in this report. That many returns should be expected from such an undertaking must be obvious to those who have had the interest and patience to read thus far.

Such returns may be divided into three groups. The first group includes those values which can be gauged accurately in dollars and

cents, such as saw-logs, fuelwood, hydro poles and Christmas trees, from both natural woodland and forest plantations.

Records are on file of woodlots yielding $35.00 an acre in saw-logs and fuelwood from improvement thinnings, in which only the over-mature, defective and suppressed trees were taken out.[1] In such work the conservation value of the area is retained and it is expected that such woodlots will be ready for further thinning in about fifteen years, and at similar intervals in perpetuity.

Similarly, forest plantations have a definite potential value. By and large, forest plantations of pine produce better and more trees to the acre than natural stands of the same age. The red pine (*pinus resinosa*), shown on Page 243, is a good example of reforestation on light land in southern Ontario. This plantation is now (1943) thirty years old. Many of the trees are over fifty feet in height and the average diameter (D.B.H.) is 6.9 inches. By measurement this stand now contains 8,325 F.B.M. per acre. In addition, several cords of wood have been taken out over the years from thinnings. At sixty years of age it is estimated that this stand will yield at least 30,000 F.B.M. per acre, which at $20.00 a thousand on the stump would be worth $600.00 per acre. To this should be added cordwood and a few saw-logs and poles from thinnings during the ensuing thirty-year period.

If, on the other hand, all suitable trees in such a plantation are used for hydro poles, the yield would be greater. It is estimated that in another thirty years this plantation will yield 150 such poles 30 feet long, and 150 poles 50 feet long, per acre, which at current prices would be worth $4.50 and $10.00 each, or a total of $2,175.00 per acre.

Also, Christmas trees from forest plantations are a crop which has come on the market in recent years. However, where these are grown for clean-cutting, that is, the removal of all trees from the area after seven or ten years, such practice is not in the best interest of conservation where such factors as soil erosion, stream protection, etc., are involved. On the other hand, most plantations will yield a small percentage of trees per acre after seven years, without interfering with the conservation value of the stand.

An example of such a thinning is the Boy Scout Coronation Tract in Simcoe County. In 1937 the County of Simcoe purchased 82 acres of non-agricultural land, as a part of its county forest, on the Thornton-Baxter road, at a cost of $410.00. The area was planted the same year with 82,000 red and Scotch pine, by a group of 120 Boy Scouts camped at the village of Angus over the 24th of May weekend. The boys were

[1]Woodlot and plantation figures supplied by F. S. Newman, Zone Forester, Department of Lands and Forests, St. Williams, Ont.

drawn from 35 different troops within a radius of 100 miles of the camp, and one purpose of the outing was to give them a practical demonstration in conservation. As the work was done gratis by the boys, the cost of planting was insignificant and involved only supervision and trucking by the regular staff of the Department of Lands and Forests. In the late fall of 1943, 7,500 Scotch pine averaging six feet in height were cut from this area as an improvement thinning, and sold for Christmas trees for thirty cents each, or a total of $2,250.00.

Such returns, as indicated from the foregoing examples, should go a long way in providing for the self-liquidation of a conservation programme such as is recommended for the Ganaraska Watershed.

The second group of returns includes a number of values which are tangible but impossible to measure statistically. These are: increased ground water, which would raise the water table of the area, improve wells and springs, and increase the fertility of the land; the retarding of erosion on crop land, with the resulting increase in crop production; and the impounding of water, which would improve summer flow and ameliorate flooding. Such values would reflect themselves in a general improvement of agricultural conditions.

The third group includes a number of values which are intangible but nevertheless important, such as roadside planting, the beautification of the landscape by improved forest conditions, increased wildlife, and recreational facilities such as boating, swimming, fishing, and winter sports. The initial work connected with carrying out such changes and facilities would have a therapeutic value for returned men who might require the solace of the out-of-doors for bruised bodies and minds. And on through the years, the use of such areas by the people of our province, both young and old, would yield returns in spiritual values, the effect of which would be immeasurable.

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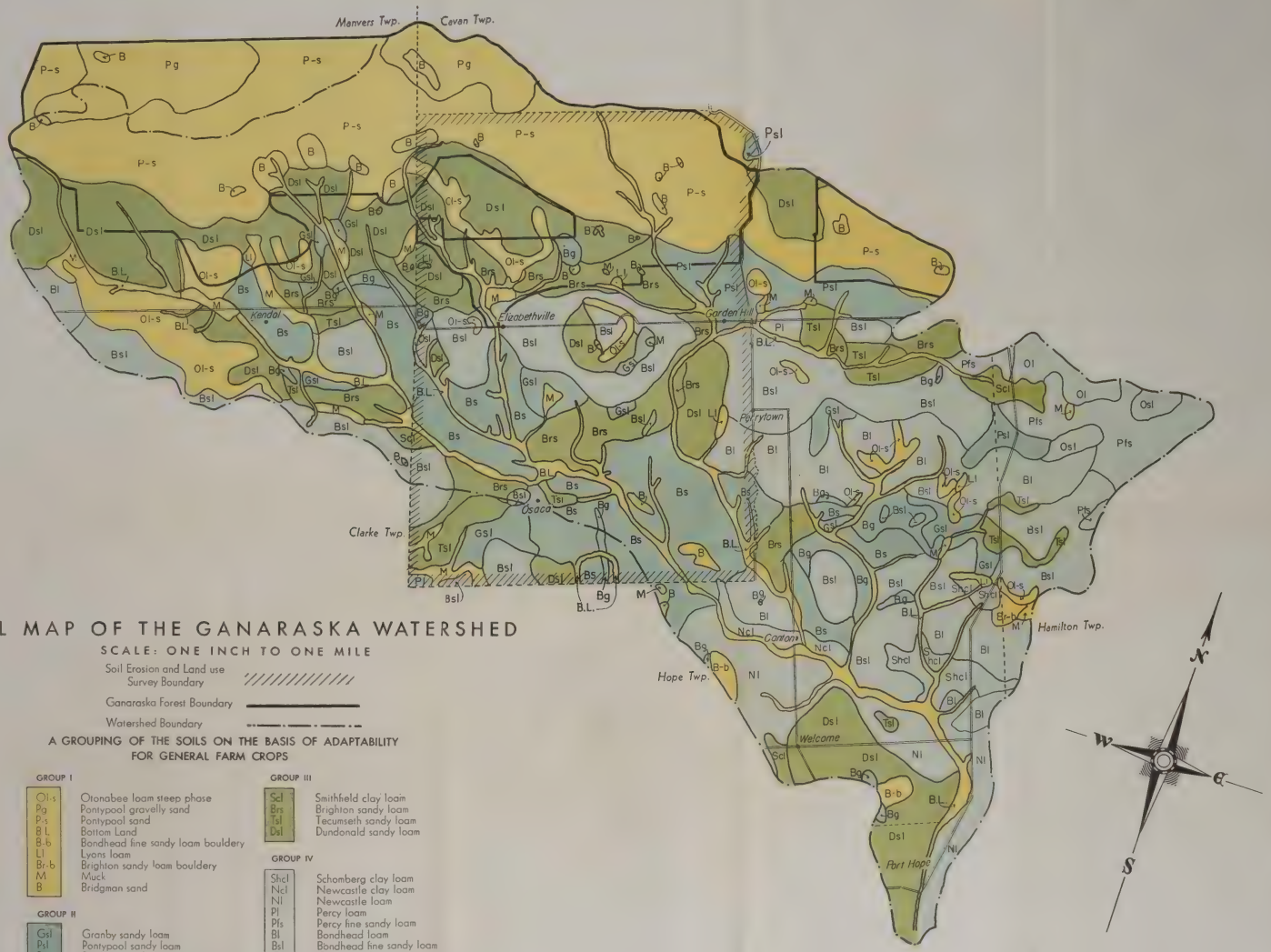
(Illustrations are in bold-faced type)



SOIL MAP OF THE GANARASKA WATERSHED

SCALE: ONE INCH TO ONE MILE

Soil Erosion and Land use Survey Boundary

Ganaraska Forest Boundary

Watershed Boundary

A GROUPING OF THE SOILS ON THE BASIS OF ADAPTABILITY FOR GENERAL FARM CROPS

GROUP I

Ol-s	Otonabee loam steep phase
Pg	Pontypool gravelly sand
P-s	Pontypool sand
B L	Bottom Land
B-b	Bondhead fine sandy loam bouldery
Ll	Lyons loam
Br-b	Brighton sandy loam bouldery
M	Muck
B	Bridgman sand

GROUP II

Gsl	Granby sandy loam
Psl	Pontypool sandy loam
Bs	Brighton sand
Bg	Brighton gravelly sand

GROUP III

Scl	Smithfield clay loam
Brs	Brighton sandy loam
Tsl	Tecumseth sandy loam
Dsl	Dundonald sandy loam

GROUP IV

Shcl	Schomberg clay loam
Ncl	Newcastle clay loam
Nl	Newcastle loam
Pl	Percy loam
Pfs	Percy fine sandy loam
Bl	Bondhead loam
Bsl	Bondhead fine sandy loam
Ol	Otonabee loam
Osl	Otonabee sandy loam

Soil survey by The Department of Chemistry, Ontario Agricultural College, Guelph and The Experimental Farms Service, Dominion Department of Agriculture, Ottawa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